THURSDAY, MAY 13, 1897.

BOOKS ON BIRDS.

Life-Histories of North American Birds, from the Parrots to the Grackles, with special reference to their Breeding Habits and Eggs. By Charles Bendire, Captain and Brevet-Major, U.S.A. (retired). 4to, pp. ix + 518; with seven lithographic plates. Smithsonian Institution. United States National Museum. Special Bulletin. (Washington: Government Printing Office, 1895.)

Feathered Friends: Old and New. By Dr. W. T. Greene, M.A., &c. 8vo, pp. 302. (London: L. Upcott Gill, 1896.)

Coloured Figures of the Eggs of British Birds, with Descriptive Notices. By Henry Seebohm, author of "Siberia in Europe," &c. Edited (after the author's death) by R. Bowdler Sharpe, LL.D., &c., Assistant Keeper, Sub-Department of Vertebrata, British Museum. Pp. xxiv + 304. (Sheffield: Pawson and Brailsford, 1896.)

A Handbook to the Game-Birds. By W. R. Ogilvie-Grant, Zoological Department, British Museum. Vol. ii. Pheasants (continued), Megapodes, Curassows, Hoatzins, Bustard-Quails. (Allen's Naturalist's Library. Edited by R. Bowdler Sharpe, LL.D., F.L.S.) Pp. xvi + 316. (London: W. H. Allen and Co., Ltd., 1897.)

Among British Birds in their Nesting Haunts, illustrated by the Camera. By Oswin A. J. Lee. Parts 1 to 3. (Edinburgh: David Douglas.)

THIS volume of the life-histories of North-American birds, the third of the series of Special Bulletins issued by the Smithsonian Institution for the illustration of its collections deposited in the United States National Museum, is the second devoted to the land birds of the United States, and is from the same pen as its predecessor, the well-known Curator of Oology in that Museum, Captain Bendire. It is with very deep regret that we observe the recent announcement that death has snatched from his hands the completion of the task for which he was so competent by his untiring observations of many years, and in which he took the deepest interest.

The present volume treats of the parrots, cuckoos, trogons, kingfishers, woodpeckers, goat-suckers, swifts, humming-birds, cotingas, tyrant-flycatchers, larks, crows, starlings, and *Icteridæ*, the classification of the Code and Check-list of the American Ornithologists' Union being followed, as in Captain Bendire's first volume. He monographs 197 species, and especially discusses the range of the birds, their breeding habits, dates of nesting, and the description of their eggs. The latter are illustrated by natural-sized chromolithographs of 110 species on seven plates, nearly all of them executed with great fidelity to nature.

The life-history of each species is full and accurate, while many of the facts given are recorded for the first time as the result of Captain Bendire's own observations in many parts of America. He has laid under contribution those, also, of his numerous personal correspondents and of his brother ornithologists throughout the States. The outcome of the whole is a solid contribution to our knowledge of the families discussed. The plates, as already said, are excellent, and the text is beautifully printed on rich, smooth paper, in the sumptuous style of the Smithsonian Committee, who, having decided that a work is worthy to be published by them, spare no cost in worthily sending it forth to the world.

Dr. Greene's book, "Feathered Friends," contains, apparently, a reprint of articles contributed elsewhere. The "Friends" noticed are exclusively cage birds; and the information about them, which might have been condensed with advantage by the omission of many of the puerile stories of the Joey and Cat adventure type, contains, no doubt, some hints useful to those who keep birds in captivity, for whom, indeed, the volume is apparently intended. The woodcuts, which illustrate some of the species described, are not of the highest style of art or reproduction.

Henry Seebohm's "Coloured Figures of the Eggs of British Birds" is, to all intents, a new edition of the fourth volume, the plates, of his British birds, with the addition of the descriptions of their nests and eggs copied from that work, with a condensed account of the distribution of each species, its laying time and breeding places. The author's lamented death before its completion necessitated the bringing out of his book under the editorship of his friend Dr. Sharpe, who has done his best to present it as he believed Mr. Seebohm would have wished it to be issued. The book, as now published, is very complete, and for the oologist is quite independent of the large four-volume "British Birds." This handsome and somewhat bulky volume contains sixty plates with the figures of the eggs of 377 species of birds, and where the eggs are subject to variation, a series of the more characteristic deviations from the normal type has also been represented. We are safe from contradiction in saying that no work on British oology has been produced in this country in which the eggs have been so faithfully and artistically reproduced; as an example, we may refer to those of the kestrels and the guillemots on Plates 4 and 55 respectively. The book will, undoubtedly, remain the standard authority on the eggs of British birds for many years to come.

Dr. Sharpe has prefaced the work with an interesting and appreciative "personal reminiscence" of the author, in which Seebohm's chief contributions—and they are numerous and important—to ornithology, are summarised, and some of his many generous gifts to the National Collection, of which he was a constant benefactor, are rather indicated than fully detailed. A specially successful photogravure likeness of Mr. Seebohm forms a fitting frontispiece to the volume. It ought to be mentioned that the chromolithographic plates are the work of Messrs. Pawson and Brailsford, of Sheffield, and they prove that the highest class of chromolithography can be done as well in England as anywhere on the continent.

The second volume of Mr. Ogilvie-Grant's "Game-Birds" forms the latest addition to Allen's Naturalist's Library. His previous volume showed him to be a most accurate and conscientious worker, and that now under review will sustain his reputation in these respects. The British Museum is fortunate in possessing one of the most complete collections of game-birds in the world, only eighteen species of those known to science being

unrepresented in it. Mr. Grant has, consequently, in preparing his two volumes, had the opportunity, of which he has with infinite pains availed himself, of comparing his descriptions with the specimens in the National Collection. It is not too much to affirm that, as a guide to this group of birds, these two volumes have no superior, and though condensed, all the essential facts of their life-histories, so far as known, are carefully set out. As the editor justly remarks, they constitute "a small monograph of the *Gallinæ*." Two species are described in this volume as new, namely *Turnix whiteheadi*, one of that excellent naturalist's numerous discoveries in the Philippines, and *Ammoperdix cholmleyi* from the Soudan.

We have had more than once to note the unsatisfactory character of the plates in Allen's Naturalist's Library. There is, however, a slight improvement in this respect in the eighteen illustrations in the present volume, as compared with those of several of its predecessors; but as bird portraits they are still far from what they ought to be, especially in a work where the standard of the text is so high. Considerable carelessness is seen in Plate xxxiv., for instance, where the colouration differs widely from the description, the result of the cheap way in which the chromolithography has been executed. The poorness of the plates, however, cannot seriously interfere with the value and usefulness of this excellent handbook.

Mr. Oswin Lee presents us with still another work on British birds! Believing that among the number of books which have been published on British birds and their eggs, many of which are beautifully illustrated, there has never been published, so far as he is aware, any complete work giving faithful representations of their nests, he essays to supply the need by issuing to subscribers, at intervals of four to six weeks, a fascicle of photographs, which he hopes "will possess the accuracy of a scientific work on the nesting habits of birds, and yet be sufficiently attractive for the ordinary lover of birds." As to the excellence of the photographs as pictures, and of the general "get-up" of the work, as judged by the portions so far issued, we can speak with unqualified praise; that the latter, indeed, should be all that can be desired, goes without saying when we mention that the publisher is Mr. David Douglas, of Edinburgh. The plates are the *raison d'être* of the book, but each illustration is accompanied by "short descriptions of the habits of the birds at the nests, the finding of them, the materials of which they are formed, and the methods employed in getting faithful photographs of those more difficult of access, some of which . . . were only secured after hours of anxious watching and much patience." The difficulties to be overcome, and the patience required to secure a satisfactory plate of a bird on or by its nest, in a natural attitude, are, we admit, very great; but we think that in many cases the results are far from commensurate with the time, trouble, and expense devoted to securing them. We have more than once expressed in these pages the opinion that, with regard to the majority of nests, a photograph, taken close enough to give the details of the materials of which they are composed, and the form and markings of the eggs, must fail to convey a true idea of their site, size, or surroundings. Take, for instance, the nests of the *Vanellus vulgaris*. No one looking at Plate i. would, without explanation, recognise it as a lapwing's nest, for it appears as if composed of large twigs placed amid strong brushwood, the photograph having been taken at close quarters, and there being no object in the picture to suggest the dimensions of the eggs and grass relatively to the area occupied. Again, that on Plate ii., instead of giving one the impression of being on a ploughed field, as is intended, seems to be built in a nook in the face of a precipitous cliff! On the other hand, the illustration of the cormorant's nest is most charming. Here we have the nest and its eggs in the foreground of a little bit of scenery which forms a true scale for our mental picture. Photographs fail, we think, too, in suggesting the texture, character, and markings of the eggs. These are faults inherent to all camera pictures. Mr. Oswin Lee's photographs are, however, the best we have seen; and his notes, if short and containing, as a rule, few new observations, are generally his own, and are interesting and accurate. The small etched tail-pieces, from his own pencil, are delightful, and often catch with great fidelity some characteristic attitude of the birds he has been describing.

GEGENBAUR'S FESTSCHRIFT.

Festschrift zum Siebenzigsten Geburtstage. Von Carl Gegenbaur. Vols. i., ii. and iii. Pp. 436, 486, and 788. (Leipzig: Engelmann, 1896.)

THE three large volumes of essays and researches by the friends and pupils of Gegenbaur, form a very remarkable monument to the influence which the great Heidelberg Professor has exercised in the world of science.

The list of distinguished zoologists who contribute to the "Festschrift" would alone attract attention, and render the book worthy of a place in every zoological library; but the impression given on reading it, is that every one of the contributors has given his best work to the volume which does honour to the great master.

To fairly criticise the several essays, or even to notice the principal discoveries and conclusions made by the different authors, would almost mean a review of modern zoological research, for the contributions deal with a great variety of zoological problems and classes of animals.

It is true that the majority of Gegenbaur's pupils have written on subjects of vertebrate anatomy; but the essays on invertebrate morphology are none the less interesting and important.

The first, and in many ways the most striking, memoir is the one by Haeckel, on the Amphoridea and Cystoidea. All through the descriptions of genera and species, which form the greater part of the essay, the reader must feel the genius of Haeckel's extraordinarily powerful and fertile mind.

Many cautious palæontologists may complain that there is too much imagination about the work; that there is little proof that the restorations represent, even approximately, the form that these extinct animals possessed. But there is not really much difficulty in distinguishing between what is recorded fact and what is not, and the real gain to science in such a memoir is that we have a clear and concise picture given to us, in words and illustrations, of the thoughts about a group

of fossils by one who has thoroughly studied them, and can boldly write down his views.

The memoir will, doubtless, be severely criticised; but it is a notable piece of work, and one which all zoologists may read with advantage.

The first part of Richard Hertwig's memoir, on the development of the unfertilised egg of the sea-urchin, deals almost entirely with the phenomena of nuclear structure and division, and the influence upon them of strychnine and other reagents. The second part of "General Considerations" is an elaborate and exceedingly clever essay on nuclear structure and sexual differentiation.

One of the most important conclusions arrived at, is that the centrosome is a body derived from the nucleus, which passes into the protoplasm of the cell in order to bring into more intimate connection the nucleoplasm and cytoplasm during the process of cell-division.

He points out that, in such cases as Actinosphærium and other Protozoa, and in the formation of the polar bodies of Asteracanthion, where centrosomes are not apparent, there is very slight connection between nuclear division and division of the surrounding protoplasm.

The argument is not convincing, and, as Farmer has recently shown, must be considerably strengthened from the botanical side, at least, before the theory can be accepted.

G. von Koch's essay, on the skeleton of the stony corals, is important and interesting; but it will not attract so much attention as it might have done, had not Miss Ogilvie's memoir, recently published by the Royal Society, been more elaborate and, many will think, better.

Of the memoirs dealing with the anatomy and development of Vertebrata, the one by Hubrecht, on the development of Tarsius, is the most noteworthy. Although the essay is compressed into only thirty pages, and illustrated by but one plate and fifteen figures in the text, it may be regarded as a summary of the most important results of this distinguished embryologist's work.

It is quite certain that the peculiar features of the early development and placentation of the Spectral Lemur could have been rightly interpreted only by one who had worked previously at such mammals as the Insectivora. The extremely important resemblance which the Tarsius embryo at a certain stage presents to the human embryo, at what is probably a corresponding stage, is pointed out by Prof. Hubrecht, and the general features are illustrated by a plate of interesting and instructive diagrammatic figures.

But the memoir is not only strictly embryological; it deals with the zoological position of Tarsius from other points of view, and the conclusions are arrived at, firstly, that Tarsius is, as regards its dentition, intermediate between the Primates and the Mesozoic Insectivora, and secondly, that Cope's genus Anaptomorphus is intermediate between Tarsius and Man.

Of the other memoirs on Vertebrata, two seem to stand out prominently as of more than usual interest and importance. These are the essay, by Klaatsch, on the application of Gegenbaur's famous Archipterygium theory to the question of the origin of the pentadactyle limb, and Rosenberg's memoir on the vertebral column of *Myrmecophaga jubata*.

The former places before the student a clearly-expressed and carefully-considered theory, and is illustrated by numerous really admirable figures. Rosenberg describes some variations he has met with in the vertebral column of Myrmecophaga, and discusses fully the vexed question of the homologies of the Vertebræ in the Mammalia.

Other contributions to this work have been made by Boas, Oscar Hertwig, Corning, von Davidoff, Solger, van Bemmelen, Scott, Seydel, Maurer and Göppert; and it is not faint praise to say that they are well worthy of a place in these volumes.

Since the above was written, the third volume of this gigantic "Festschrift" has been forwarded to us. It is even larger and more profusely illustrated than the first two volumes, and is entirely devoted to questions of vertebrate anatomy. Four of the seven memoirs are concerned with the cranial and spinal nerves. Goronowitsch confines his attention to the Trigemino-facialis complex of Lota, and Haller to the Vagus group of the bony fish, the two essays taking the modest share of one hundred pages.

Unfortunately, perhaps, G. Ruge, who writes on the facial nerve of vertebrates, and Fürbringer on the spino-occipital nerves of the cartilaginous fish, have been unable to confine their contributions within these limits. To attempt to criticise the 600 pages which they take, would mean an attempt to criticise an encyclopædia of vertebrate knowledge. The student, however, will find in them a mass of solid facts which have important bearings on many important questions that are much discussed in these days. Fürbringer's memoir in particular, although overpowering in its size, has many passages which summarise, in a clear and masterly manner, questions of the homologies of nerves, and in this respect, at any rate, will form a most useful work of reference for anatomists.

Of the remaining three monographs the most important appears to be the one by Semon, on the excretory system of the Myxinoids. As in the earlier works of this distinguished anatomist, the reconstruction figures he gives are admirable.

Max Weber's interesting essay on the brain weight of Mammals, and Leche's researches on the teeth of recent and fossil Lemurs, are important contributions to knowledge; and although much shorter than others in this volume, are not the less valuable indices of the character of the work that has been produced by the pupils of Carl Gegenbaur.

THE DREARY DESERT OF NORTH TIBET.

Works of the Tibet Expedition of the Years 1889–1890, *under M. V. Pyevtsoff*; Part iii. 4to, pp. 127; with six maps. Published by the Russian Geographical Society. (Russian.) (St. Petersburg, 1896.)

THIS third part of the excellent publication issued by the Russian Geographical Society, contains the records of the incursions of Roborovsky and Kozloff into the border-ridges of the great Tibet plateau. While the main body of the expedition followed the northern foot of the Astyn-tagh border-ridge (or the "Russian Moun-

tains"), *viâ* the oases Niya and Cherchen, to lake Lob-nor, Roborovsky and Kozloff, with two or three men, pushed into the mountains, and beyond, into the wildernesses of the northern part of the Tibet plateau. These excursions, which were made under great difficulties, and in one of which Roborovsky's party was very nearly lost, are described in the present part of the "Works" of the expedition, and illustrated by six maps on the scale of 13 miles to an inch. The most important of these reconnoitring expeditions was the second, made by Roborovsky, when he crossed the Astyn-tagh, and, following a valley at its south-eastern foot, between the Astyn-tagh and the steep snow-covered Uzu-tagh, reached the Keria river, as it issues from the Tibet plateau and turns north-westwards, fringing the mighty glacier-covered Kuen-lun. No inhabitant of Kashgaria ever went that way, and nobody ever came to Kashgaria from that quarter; only a few gold-diggers visit the above-mentioned valley, without ever daring to penetrate further south into the dreary wilderness of the high plateau. Roborovosky did so, notwithstanding the terrible snow-storms, one of which, on May 22, covered the ground with three inches of snow. After having reached the Keria river, which flows at an altitude of 14,300 feet, and must be a mighty stream in summer, Roborovsky returned; but he came once more to the same spot, a couple of weeks later, moved by the desire of crossing the Uzu-tagh and of casting a glimpse on the dreary desert in the south of it. The altitude of the desert was 16,600 feet, and on June 12–14 almost no signs of life were found on it. Its surface is covered with low rows of stony hillocks, consisting of sharp-edged broken strata of quartzite, running west and east. A few bushes of a willow were found after a 22 miles' march, but no lichens were seen; and the only animals noticed were a few broken-down *orongo*-antelopes, which slowly walked within a few yards from the party—too weary to pay attention to it. Only snow seems to fall all the year round in this desert, and rain must be quite unknown. In June, snow fell every day, and evaporated immediately. On June 15 the altitude was 17,080 feet, and the temperature $-12°$ Celsius in the morning. The horses were severely suffering from the sharp stones, and broke down; so that the party was compelled to return, after having covered only 40 miles southwards. The desert stretched further south, as far as the foot of the snow-covered Kuen-lun. The return journey was extremely difficult, one horse only being able to stand it; and it was in a desperate condition that Roborovsky's party reached a spot where they had left some of their provisions.

The sand-storms in that part of Kashgaria, at the foot of the mountains, are simply terrible. The loess-terrace, which fringes the highlands, is easily destroyed by the wind, and the dust is carried in the air, becoming occasionally so dense that complete darkness prevails—nothing being seen at a distance of some ten yards. If it rains during such a dust-storm, the drops of rain evaporate as they fall, and the dust they carry with them falls in the shape of small lumps. Whole forests of poplars are buried in the loess-dust hillocks, forty feet high being blown round the trees, which soon die and slowly decay, after the wind has carried the hillock away, to spread the dust further on.

Another excursion into the highlands, during which nearly 500 miles were covered and mapped, was made to lakes Achik-kul, Chom-kum-kul, and "Unfreezing"—a salt lake at an altitude of 13,300 feet, which has various species of *Gammarus* among its fauna—and to Prjevalsky's Ridge, which is a mighty chain of mountains, buried in snow, running west and east under a number of local names, and very rich in animal life in its northern spurs.

A fourth excursion was made along the Cherchen-daria, which flows in a flat-bottomed valley, and has on both its sides two strips of sands, arranged by the wind in the shape of *barkhans* (rows of hillocks), attaining the extraordinary height of 360 feet. Great numbers of wild camels, stags, antelopes, wild cats, boars, and masses of small rodents and spiders, belonging to a variety of species, inhabit these sands, while the banks of the river are covered with poplars, tamarisks, and rushes. Traces of recent desiccation are found everywhere, and immense spaces are occupied with marshes, now covered with rushes, and strewn up with masses of fresh-water molluscs—the former inhabitants of a great lake. The population of the Lob-nor depression consists of half-breeds between Aryans and Turco-Mongols, who live in huts made of rushes, keeping some cattle, and carrying on fishing to a great extent.

The accounts of Roborovsky's and Kozloff's excursions to lake Bagrach-kul, near Karashar, and Kozloff's, up the Konche-daria, are also full of interest, and, like the preceding, give a good idea of the physical characters, flora and fauna, of the visited regions. General Pyevtsoff's discussion of Roborovsky's altitudes and astronomical observations completes this very interesting volume.

P. K.

OUR BOOK SHELF.

Algebra for Beginners. By T. Todhunter. New edition, revised and enlarged by S. L. Loney. Pp. xxxvi + 428. (London: Macmillan and Co., Ltd., 1897.)

THIS excellent elementary treatise is too well known to require detailed description in these columns, so we need only refer to the changes which have been made by the reviser of the new and enlarged edition. Prof. Loney has given additional chapters on negative quantities, the theory of quadratic equations, logarithms, and miscellaneous theorems, each of which has been inserted in those parts of the book which seemed most appropriate. The chapter on factors has been rewritten, and chapters towards the end have been considerably expanded. By renumbering the paragraphs, and maintaining the old numbers in smaller type, the reviser has facilitated the use of employing both editions together; the newly-added paragraphs contain only one—namely, the new—system of numbers. As examples form a very important part of such an elementary book as this, Prof. Loney has thought fit to more than double the original number, the answers being, as usual, included in the list at the end. Teachers will thus find in this edition a most complete and efficient course, and one especially adapted for boys commencing the subject.

Picture Lessons in Natural History. A series of diagrams on roller. (London: G. W. Bacon and Co., 1897.)

THE four sheets before us, which, we presume, form only a portion of the series, include the Protozoa and "Invertebrates." From all points of view they seem admirably

adapted to give to the young student a clear idea of the leading structural features distinctive of the different groups of animals. The figures are well selected, well drawn, and well coloured, and are of a size sufficiently large to display the structure of each type of animal. The letter-press is written in exact and yet such popular language as to be easily understood by the most unscientific.

Although the author has seen fit to conceal his identity, certain peculiarities in spelling (*e.g.* "armored" and "centipeds") suggest that he is an American. It would have been better if a little more attention had been given to proof-reading, and we should not then have met with "chitin" on one sheet, and "chitine" on the next, while certain errors in punctuation would have been avoided. It seems a pity to allude to the argonaut as the nautilus, and a figure of the pearly nautilus ought certainly to have been introduced. We fancy, too, that the common gaper (*Mya*) will be somewhat unfamiliar to English students under its American title of "clam." R. L.

A Guide to the Fossil Invertebrates and Plants in the Department of Geology and Palæontology in the British Museum (Natural History). Pp. xvi + 158. (Printed by order of the Trustees, 1897.)

THE guide-books prepared by officials of the Natural History Museum at South Kensington, to interest visitors in the collections under their charge, are models of what guide-books should be; they are concise in text, often well illustrated, and marvellously cheap; and the persons who digest them obtain a liberal education on the subjects with which they deal. In this new Guide, prepared under the direction of Dr. Henry Woodward, the fossil invertebrates and plants represented by specimens and drawings in the Natural History Museum are described; the characteristics of the living organism, as well as of the parts found in a fossil state, being placed before the reader. With this Guide in his hand, the student of geology and palæontology will be able to derive the fullest advantage from the admirably-arranged geological record at South Kensington.

Report on the Causes and Prevention of Smoke from Manufacturing Chimneys. By Dr. Harvey Littlejohn, M.A., M.B., B.Sc., Medical Officer of Health. Pp. 51. (Sheffield: Wm. Townsend and Son, 1897.)

DR. LITTLEJOHN drew up this report, upon the subject of the smoke nuisance in Sheffield, at the request of the Health Committee. He gives a short account of the past history of the subject, which occupied the attention of a Select Committee of the House of Commons so far back as 1819. Sheffield has an unenviable notoriety for smoke, owing, of course, to the fact that a large number of its manufactures depend almost wholly upon the combustion of coal. Dr. Littlejohn suggests that further restrictions be imposed on the amount of smoke emitted by steam-boiler furnaces, but no special form of apparatus for preventing excessive smoke is recommended, the opinion being that greater care and attention in firing would considerably lessen the nuisance.

Birds of Our Islands. By F. A. Fulcher. Pp. 368. (London: Andrew Melrose.)

WITH the multitude of readable books which now exist on British birds, it is almost a reproach to be without a knowledge of bird-life. In this dainty volume the characteristics and habits of birds, and the curiosities of bird-land, are pleasingly described. The book is not an exhaustive treatise, but a collection of word-pictures drawn by the author in various parts of the British Isles. It is simple-worded; nevertheless, it is instructive, and it will lead its readers to look about them so as to see for themselves how interesting are the works of nature. The book would be a very acceptable present for a boy with a taste for natural history.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Theory of Dissociation into Ions.

I AM glad that Mr. Dampier Whetham has noticed the two experiments which I adduced against the present theories of osmotic action and dissociation respectively. The force of the first of these experiments he admits, but, as regards the second, I fear that he can hardly have realised the true results of the experiment, or else I do not realise the meaning of the explanation which he offers of it.

The experiment was: That when a mixture, represented by $100H_2O + H_2SO_4$, is put into excess of acetic acid, the lowering of the freezing-point of the latter shows that the mixture contains less than 101 acting units, instead of more, as would be the case if the H_2SO_4 molecule was dissociated into ions. The actual number of acting units indicated was about 70. (I have only an abstract of the paper by me: it will be found in the *Berichte*, 24, p. 1579.) Mr. Whetham's explanation is that the acetic acid takes the water away from the sulphuric acid, and this latter goes into solution as such in the acetic acid, and in this solvent it is undissociated. But even if this were so—and a determination of the conductivity of the complex solution should tell us at once whether it is, or not—we should still have our 101 acting units ($100H_2O$ and H_2SO_4) in the acetic acid, or, even if the sulphuric acid molecules combined with each other to form complexes, we should have, at any rate, something more than 100 units; whereas, as a matter of fact, we find only 70. Complete recombination of ions, and complete polymerisation of the sulphuric acid is quite incapable of explaining the reduction of the number of acting units present.

To quote some actual values: 16·8 molecules of water lower the freezing-point of 100 molecules of acetic acid 7·32°; 0·097 of a molecule of sulphuric acid lowers the freezing-point of 100 molecules of acetic acid 0·038°; the two together should lower the freezing-point of acetic acid 7·358° if they acted on it independently of each other, but the actual lowering which they produce is only 7·03°; therefore, they do *not* act independently of each other. The two together have even less action than the water only.

As an alternative explanation, Mr. Whetham suggests that "dissociation of the ions from *each other* does not forbid the assumption that the ions are linked with one or more solvent molecules." Quite true: but when a theory can only explain observed facts by driving us to assumption of the existence of such compounds as H_2H_2O and $SO_4.yH_2O$, I venture to think that that theory must be somewhat shaky.

Harpenden, May 1. SPENCER PICKERING.

I AM very glad that Mr. Pickering has given further details of his experiment. From his former letter I did not gather that the number of acting units indicated by the freezing-point of the solution of $100H_2O + H_2SO_4$ in acetic acid was as low as now appears. The result is most interesting, and seems to me to furnish strong evidence for the modification of the dissociation theory for which I am contending, under the belief that, in spite of the last paragraph of Mr. Pickering's present letter, it furnishes the best explanation of *all* the facts. Had the number of acting units indicated been nearer 100—say 90, or more—it would have been possible to explain the experiment in the first way which I suggested, for the freezing-point of a solution of water in acetic acid shows that some of the solute molecules are polymers of H_2O (Raoult's value for the molecular depression is 33·0, as compared with 38·8 found from Van 't Hoff's formula, which agrees well with Raoult's values for other substances). This would reduce the number of acting units in the case of the mixed solution also, and even complete dissociation of the sulphuric acid would be insufficient to bring that number up again to 100.

This explanation, however, seems to me to be entirely upset by the result that the lowering of freezing-point produced by a mixture of water and sulphuric acid is actually less than that produced by the water alone. Certainly, as Mr. Pickering says, the water and sulphuric acid "do not act independently of each other"—at least, when dissolved in acetic acid. I do not think it quite logically follows that they are combined when

alone; but it certainly seems probable, and I have no wish to raise such an objection.

If we admit, then, that combination does occur when sulphuric acid is dissolved in water, as there is much evidence to show, need we abandon the dissociation theory? I think not; in fact, Mr. Pickering admits that my alternative explanation meets the case under discussion.

Mr. Pickering has made no attempt to explain the electrical phenomena I described in your issue of April 29, by any means other than the assumption of dissociation of the ions from each other. I know the idea of such dissociation is abhorrent to people who are fortunate enough to possess an orthodox chemical conscience; but, till some one has accounted for the electrical relations in another way, its acceptance seems to me to be a necessary consequence of the facts.

I cannot quite see the force of Mr. Pickering's objection to the idea that the ions are linked with one or more solvent molecules. There is no need to assume the existence of definite compounds, which could be crystallised out and handled. If we admit the presence of charged ions free from each other, electrical forces will certainly exist between them and the solvent. We know too little, as yet, about the mutual relations of atoms and their charges, to picture exactly what occurs; but these forces must produce some sort of connection between the ions and the molecules of solvent. This connection, of course, only remains unmodified as long as the dissolved body keeps in solution.

Such a view of the dissociation theory seems to me to offer many advantages. It may be contrary to some *opinions*, but I do not think any *facts* have yet been pointed out which refute it. Till they are, it may possibly be of some use as a working hypothesis in the investigation of that complicated structure which we call a solution. W. C. DAMPIER WHETHAM.

Trinity College, Cambridge, May 5.

On the Feathers of "Hesperornis."

A NUMBER of years ago I published in NATURE (December 25, 1890, p. 176) my opinion "On the Affinities of *Hesperornis*," agreeing, at the time, with Prof. D'Arcy Thompson and others, that those toothed birds of the Kansas Cretaceous beds saw their nearest allies in existing birds in the Loons and Grebes, or in the typical Colymbidine assemblage. In other words, the now-living pygopodous birds, such as *Urinator*, *Colymbus*, and so forth, are, by descent, the modern representatives of the ancient *Hesperornithidæ*, whether that descent or origin be direct or indirect. There are osteological characters, which the limitations of space will forbid dwelling upon here, that tend to convince me of the probability of the Grebes (*Podicipoidea*) being an earlier offshoot of the pygopodine stem than the *Urinatoroidea*, and so more nearly related to *Hesperornis* than the latter birds.

Re-stimulated by a brief article, by Prof. S. W. Williston, in *The Kansas University Quarterly* (vol. v., July 1896, pp. 53, 54, plate ii.), entitled "One of the Dermal Coverings of *Hesperornis*," Prof. O. C. Marsh takes occasion, in a recent issue of NATURE (No. 1432, vol. lv., April 8, 1897, p. 534), to once more advance the theory—and one which originated with him, and, fortunately, has received but meagre support—of *Hesperornis* having been nothing more nor less than some peculiar kind of "a swimming ostrich." This view of its taxonomic position has never been accepted by the present writer; and it would seem that many other comparative anatomists experience quite as much difficulty in believing that those ancient divers were any more "swimming ostriches" than the modern types of the *Struthionidæ* are a sort of group of gigantic terrestrio-cursorial divers.

Prof. Marsh is not the only writer that has been led astray in some parts of avian classification by employing what have been called "struthious characters" in avian osteology, and now he thinks his views are supported by the recent discovery of Williston, referred to above. Having carefully examined the published plate of the latter author, I must say that I am quite sceptical as to what he believes to be long tarsal feathers in *Hesperornis*. Surely, in the figure, the resemblance to feathers is very remote; and, quite as surely, long, drooping plumaceous feathers hanging down *to the feet* in a big, powerful *diver*, would in no way whatever assist it in either swimming or diving. In fact, just so soon as these soft, plumaceous feathers became thoroughly wet, they would naturally form a serious impediment to the proper use of the pelvic limbs in their forward and backward strokes; and one has but to study the action of these limbs in swimming, in our modern Loons, to appreciate this point. That *Hesperornis* possessed some kind of a plumaceous plumage, however, I long ago believed, and see no reason to change that opinion now.[1]

Plumaceous plumage was very likely far more prevalent among the earliest birds in time, than it is now among the modern types; and this applies absolutely to not a few characters in the skeleton. The latter, along whatever line we may trace them, are evidences of an approach reptile-wards, and by no means always point to struthionine affinity. Certain peculiarities in the pelvis, and at the base of the cranium, when associated with certain others, have, as I say, been unfortunately termed "struthious characters," and, with this mistaken idea operative, our more superficial avian anatomists can see but little beyond "ostrich" in either *Finamon* or *Apteryx*. Not so, however, is this the case with the more profound researchers, of which Prof. Max Fürbringer is so able a representative. There is no more ostrich in *Hesperornis* than there is diver in *Struthio*—how much of the latter there may be, I willingly leave Prof. Marsh to consider. R. W. SHUFELDT.

April 28.

On Augury from Combat of Shell-fish.

IN his "Józankidan Shúi" (published about 1767, tome i. fol. 3, *a*) Yuasa Shimbei, a Japanese literatus (1708–81), writes on this subject thus:—"Noma Samanoshin narrated that the destiny of a belligerent could well be foretold by means of the 'Tanishi.'[2] If two groups consisting each of three of this shell-fish be placed in opposite corners of a tray, the three animals representing the future conquerors would advance, while the others, which are doomed to defeat, would withdraw. This method was approved by repeated experiments during the siege of Osaka [1615].[3] Every time the experiment was carried on, it never failed for the three 'Tanishi,' respectively designated Hideyori, the lord of the castle, and his two generals, Ôno and Kimura, to be driven in corners by other three which were representing the leaders of the besieging army, Prince Iyeyasu, Ii, and Todô. Thence it is confirmed that there is no better method of foretelling the decision of a war [here Nonaʼs narrative ends]. The same method is given in detail in 'Wu-pei-chi' [by Mau Yuen-i, completed 1621], which is to be consulted for its particulars." Unfortunately all four copies in the British Museum of the Chinese work, here referred to, are wanting vol. clxxxvi., wherein further details of the method are said to be found.

Besides, two older Chinese works, both of which I have never seen, viz. Fung Ching's "Pan-yu-ki"[4] (written *circa* 990–94) and Luh Wei's "Kwei-che-chi"[5] (twelfth century) are said to describe this method of augury to have been of old used in the region of Ling-Nan (which comprised the present provinces of Kwang-Tung and Kwang-Si).

In connection with Yuasa's statement above quoted, the following notice, by Etienne Aymonier, of a Cambodian mode of divination is equally interesting:—"Si une armée étrangère fait invasion dans le royaume, beaucoup d'habitants prennent deux *Khchau*,[6] placent au fond d'un bassin, d'un récipient, un peu de sable pour faire une petite arène et assez d'eau pour recouvrir les deux coquilles. Ils allument des bougies et des baguettes odoriférantes, invoquent les divinités protectrices du royaume, les prient d'indiquer l'issue de la guerre au moyen de cette petite naumachie. Les *Khchau* représentant les belligérants luttent jusqu'à ce que l'un des deux soit culbuté"[7] ("Notes sur les Cou-

[1] See my article, "Feathered Forms of Other Days," *The Century Magazine*, January 1886, p. 357.

[2] "*Tannigi* are the common black Land Snails gather'd for Food in muddy Rice Fields. . . ." (Kaempfer, "History of Japan," 1727, vol. i. p. 141). It belongs to the genus Viviparus, and is *V. japonica*, if I remember correctly.

[3] For this event see, *e.g.*, Caron's "Account of Japan," in Pinkerton, "Voyages and Travels," 1811, vol. viii. p. 616; "Diary of Richard Cocks," 1883, *passim*.

[4] Referred to in Li-Ye, "King-chai-ku-kin-tau" (written *c.* 1234, Brit. Mus. copy, 15,316, *d*, tome iv. fol. 27, *a*).

[5] Quoted in the Grand Imperial Cyclopædia, "Ku-kin-tu-shu-tseih-ching," sec. xix. tome clxiii. sub. "Lo-pu-ki-shi," fol. 3, *a*.

[6] J. Moura, in his "Vocabulaire Français-Cambodgien, &c.," Paris, 1878, simply explains the word "khchau" as "coquille." From parallel instances it is highly probable that this is, too, a species of the Paludinidæ.

[7] This notice reminds me of an old Japanese tradition, which is this. "When the battle of Dannoura was about to be fought (1185) [for which battle see Adams, "History of Japan," 1874, vol. i. p. 36], Kumano-no-Bettô Tansô, a warlike priest, who was wavering in question which of the

tumes et Croyances superstitieuses des Cambodgiens," in *Cochinchine Française; Excursions et Reconnaissances*, No. 16, p. 142, Saigon, 1883).

So far the practice of augury from combat of shell-fish appears to be a peculiarity of the peoples in the Far East. Is there any instance of the same method described in other parts of the world?[1] KUMAGUSU MINAKATA.

May 3.

Luminous Phenomena Observed on Mountains.

On Easter Monday, 19th ult., I was ascending Braeriach by its well-known northern ridge, and, shortly after I had crossed the "snow-line," I witnessed a phenomenon of great beauty, the explanation of which I cannot give. The edge of my plaid, of my gloved hands, of my knickerbockers, &c,, was bordered by a two-inch band of brilliant violet light, at the moment of beginning any movement. The light was not visible around anything at rest, nor did it persist; but only showed at the moment when rest was changed for movement.

My attention was directed to this for a very short time only, for heavy snow began to drive in my face, and I had to watch where I was going, as the immediate surroundings included dangerous ground.

After my return, I found an account of a somewhat similar appearance in the *Cairngorm Club Journal*, vol. i. p. 159. I copy the account as there given by Dr. John Gordon, of Aberdeen:—

"Half-way across the snow-slope, while the sun was somewhat obscured, but was still sending a considerable intensity of light, we observed a strange phenomenon. On the side of our body next the snow-slope there was a nimbus of violet light, which clung to clothes, naked fingers, and the shaft of the ice-axe. So plentiful did it appear in the palm of the hand that it looked at times like a pool of violet ink, and one thought it could be pitched away. On shaking the hand, however, the nimbus clung, and was not to be removed. Occasionally the colour varied, taking on shades of brownish-yellow and blue, but violet was the most marked colour. At another time, in much the same condition of light and snow surroundings, one of the party, who was very proud of the beauty of the silver case of his compass, was disgusted to find that it had a distinctly yellow, pinchbeck look. This light refraction or polarisation [?] was not so evident to some of the party, but the writer has observed it before in similar circumstances and atmospheric conditions."

I may add that, in my own case, no direct sunlight reached me, as I was in the lower part of a dense cloud or mist. Some of your readers may offer an explanation of this remarkable and beautiful appearance. C. G. CASH.

Edinburgh Academy, May 3.

The Utility of Specific Characters.

UNDER the above heading, in your issue of April 1, Mr. J. T. Gulick has an interesting communication, in which he asks whether it is possible to explain right-handedness, the dextral or sinistral coil of snail-shells, and similar features, as having any utility to the species of which they are certainly characteristic. Can it be due to natural selection that one snail is dextral, while another is sinistral?

It is a curious fact, I think first pointed out by Mr. Call, that in the American freshwater shells of the genus *Campeloma*, *sinistral shells are more numerous among the young than among the adults*. Thus, for example, Mr. H. A. Pilsbry (*Nautilus*, February 1897, p. 118), states that Miss Jennie E. Letson examined a lot of *Campeloma decisum* for him, with the result that, "out of 681 specimens, mainly adult, but including those from one-fourth grown up, none were sinistral. Out of 410 shells of the uterine young, 3 were sinistral, slightly over 0·73 per cent." He adds: "Probably all who have collected Campelomas have noticed the greater proportion of sinistral examples among the young shells. This doubtless indicates that the reversed condition is an unfavourable one for maturation."

So here, at any rate, we have some direct evidence as to selection. I think it will strike any one, that while left-handedness might be as good for the race as right-handedness, *there is a distinct advantage in uniformity*, and that consideration alone may perhaps suffice to explain Mr. Gulick's difficulty. Among plants it may seem less obvious, but where seedlings are crowded, uniformity may save space, just as a number of objects of the same shape can usually be packed into less space than those of diverse shapes. More plants can grow in a window-box where all bend to the light, than would be possible if half of them bent one way and half another.

There also occurs to me a theoretical consideration, perhaps of doubtful value. When a germ has diverse potentialities, so that it is left to germinal or environmental selection to decide which course it shall take in development, there must, apparently, be a certain waste of germinal energy. Any disadvantage thus arising is ordinarily much more than counterbalanced by the gain due to the adaptability of the organism, or in social species to the power of specialisation of the individual for social purposes. But it may be that when no such advantage is found, there exists a small disadvantage in deviations, potential or actual, from a common standard.

What we really need, in discussing these matters, is the observation of actual facts. The facts above related as to *Campeloma* are worth more than any amount of theoretical considerations. T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., April 21.

The Motion of an Iron or Steel Ball in a Magnetic Field.

IN NATURE, April 29, a method, reprinted from the *Physical Review*, is given for illustrating the motion of a particle under the action of a force varying inversely as the square of the distance. I think it ought to be pointed out that the force on a small iron or steel ball, due to a single magnetic pole, is not inversely as the square of the distance. It may be shown without difficulty that if the strength of the pole be μ, the susceptibility of the iron or steel to magnetisation κ, and τ the volume of the ball supposed exceedingly small, then the force towards the pole is

$$-\tfrac{1}{2}\cdot\tau\cdot\frac{\kappa}{1+\frac{4}{3}\pi\kappa}\cdot\frac{d}{dr}\left(\frac{\mu^2}{r^4}\right)$$
$$=\frac{2\kappa\tau}{1+\frac{4}{3}\pi\kappa}\cdot\frac{\mu^2}{r^5}.$$

Thus, assuming that κ is constant during the motion of the ball, which, of course, it is not, the force is inversely as the fifth power of the distance, and the curves given can not be regarded as even approximate representations of planetary orbits, but rather as rough representations of orbits described about a centre of force whose law is the inverse fifth (see "Tait and Steele," p. 151). ALEX. ANDERSON.

Queen's College, Galway, May 3.

THE NEW SOUTH AFRICAN MUSEUM.

THE new South African Museum is situated at the upper end of the Municipal Gardens, about a quarter of a mile distant from the old building, which will now be entirely occupied by the public library.

The new building consists of two floors, of which the upper one contains the principal exhibition rooms; the large room, measuring 63 feet by 41½ feet, is devoted to the birds, reptiles, and fishes of South Africa; and there also is the cast of the skeleton of the restored triassic reptile, *Pariasaurus bainii*, Seeley. It is also hoped that at some future time other casts and originals of some of these remarkable extinct forms may be exhibited, among which we may perhaps find the progenitors of our modern mammals. The corresponding room is devoted to the general collection of vertebrates. A small room contains the anthropological collection, both South African and general.

two antagonist clans to support—Minamoto or Taira—doubting the accuracy of an oracle given by his patron-god to induce him to serve under the White Banner [*i.e.* the Minamoto clan], caused seven white cocks to combat with seven red ones before the shrine of the same deity. And the result was that the red ones [which represented the Red Banner of the Taira clan] were all defeated by white ones, which impelled him to make up his mind to serve the Minamoto clan" ("Heike Monogatari," tome xi.).

[1] Of allied modes of divination about the decision of a war, I may instance the New Zealander's practice with sticks, and a Gothic king's experiment with swine (see Lubbock, "Origin of Civilisation," 5th ed., p. 245; and Mary Howitt's Appendix to Ennemoser's "History of Magic," ed. Bohn, vol. ii. p. 458).

The remaining room is entirely devoted to the South African mammals, among which are an excellent series of antelopes, chiefly obtained for the Museum by Mr. Selous; and the white rhinoceros, which was shot in Mashonaland about two years ago by Mr. Eyre, and was presented to the Museum by the Right Hon. C. T. Rhodes.

The three rooms first mentioned are lighted by windows, and the cases placed at right angles, much in the same fashion as in the larger galleries of the Natural History Museum at South Kensington. The South African mammal room is lighted from above, and the cases extend all round the walls, together with four very large free standing cases arranged in the middle of the room. All the cases are made entirely of iron and plate-glass, on what is generally known as the Dresden system. This was found necessary in consequence of the great difficulty which has hitherto been met with owing to the warping of all woodwork in South Africa, which entirely prevents wooden cases from being secure from the attacks of insect pests.

On the ground floor, on either side of the entrance hall are two rooms; of these, the larger one on the left contains the invertebrate collections; the smaller, the antiquities. Amongst these latter, there are a certain number of pieces of glass and china of considerable artistic merit, brought to the Cape by the Dutch settlers in the early days; and also one of the so-called post-office stones on which, before any settlement existed, the captains of passing ships used to engrave the dates of their arrival and departure, and notices requesting subsequently-arriving captains to search near by for letters. Similar stones are still occasionally found in the centre of Cape Town, when excavations are made.

The corresponding rooms on the right of the entrance contain the geological collections; the general collection in the larger room, the South African in the smaller. In the latter a special feature will be the exhibition of specimens relating to the gold and diamond industry. These rooms are fitted with desk-cases, with underlying drawers, also entirely constructed of iron and glass.

The small rooms, together with those underneath the South African mammal room, are the offices, the library, and study-collections in cabinets and preserved in spirit. Apart from the main building is a large taxidermist shop and store room.

Great interest was shown in the recent formal opening of the Museum by the Prime Minister, Sir J. Gordon Sprigg. A long report of the ceremony appeared in the *Cape Times*, and is here abridged.

The Hon. J. X. Merriman, addressing Sir Gordon Sprigg, and those present, said it had fallen to his lot as the senior trustee to ask him to open the Museum. The occasion marked a very important stage in the history of the Museum, and he could wish it had fallen to some one more scientific than himself to sound the praises of the institution. But, in another way, it was fit that he should say a few words, as he was perhaps the only one in the assembly, except Sir Richard Southey, who recollected the Museum in its infancy. When a boy, in the year 1855, he was always interested in going to the Museum. It was due to two gentlemen who had now passed away, Mr. E. L. Layard and Mr. Charles Fairbridge, that the Museum was first founded. It was then put in the old Slave Lodge; and it was mainly owing to their exertions, and to the interest taken in it by Sir George Grey, that the new Museum and Library was built, and that the Museum migrated there, where it remained for a great many years. At first Mr. Layard was the curator; and amongst the trustees who deserved mention were Sir Richard Southey, who only vacated his office on being appointed Governor of Griqualand West, and Sir Thomas Maclear, the Astronomer Royal, who was now dead. The room was found to be totally inadequate to the size of the collection, and after some negotiations with the Government a grant was obtained, and the result they saw in the building they were now going to open to-day.

He thought it would be fitting that he should say a few words as to some of the aims and objects in arranging the Museum in that building. The prevailing idea, he was afraid, was that a museum was a collection of all sorts, and oddments and curiosities; and the name, like the honourable name of professor, had been a good deal brought down; for instance, they had Barnum's

The New Museum at Capetown.

Museum—and he was afraid people were inclined to imagine the Museum to cope with that magnificent receptacle for the bearded woman and the two-headed calf. The aim, however, of this Museum was that it should really be, in a sort of way, the home of research in South Africa; that whatever scientific research there was in South Africa should find its home within the walls of the South African Museum, and that the collections should be so arranged as to illustrate the different branches of scientific research in that country. The Museum was under the general direction of Mr. Sclater, who had thrown himself into his work with a zeal and efficiency which left nothing to be desired. He had taken upon himself the management of the special branch—that of mammalia—the largest animals of South Africa. These were a vanishing class, owing to the rapidity of progress; for the spirit of civilisation was rapidly destroying all these interesting animals, which made South Africa at one time famous throughout the world.

It was sixty years ago since the great naturalist, Darwin, drew a remarkable picture of the mammalia of South Africa. He drew attention to the fact that the mammalia of South Africa were the largest and most numerous in the whole world; and he compared them with the mammalia of Brazil, and showed in what an extraordinary proportion the weight of our animals exceeded that of the South American animals. Now they had got rid of their mammalia here, and were importing frozen meat; and this could hardly be said to be improving nature. Before the mammalia were extinct, it was very desirable that a collection of them should be formed, and they would see a beginning had been made in this direction. Another branch the assistant curator, Mr. Peringuey, had taken under his charge, viz. the important division of entomology, or the study of insects. Some people, little thinking of the important part insects played in the world, smiled, but it was an insect that cost France more than the Franco-Prussian war; it was an insect that formed their most acute political differences in this country. When he ran through the important part that insect-life played, he sometimes wondered how it was possible for man to exist on the face of the earth at the same time. They also had another gentleman working in the same direction as Mr. Peringuey, viz. Mr. Lounsbury, the able entomologist. They wished, however, to make the Museum the home of insect life—though not of live insects.

Dr. Corstorphine was in charge of the geological section of the Museum, which up to the present time had been neglected. Dr. Corstorphine was making good progress, and in connection with that the Geological Commission had its home in the South African Museum. Dr. Purcell, a South African, had set a fine example. After studying in the science schools of Europe, he came out here to spend his life; he was in charge of the invertebrate section; and finally there was Mr. Gilchrist, who had come out as an expert upon fisheries, and who was in charge of the marine section. So that all the branches were fairly well organised, and the scheme, they would admit, was a good one if it could be carried out. For the organisation the greatest thanks were due to his two fellow trustees, whose zeal and energy deserved all praise. On the Board of Trustees he represented the Philistine element, so he could lay no claim to credit for the scheme of scientific research.

Only one thing seemed to be lacking, and that was a very common thing indeed—that was, that they needed funds; they were crippled for want of money. Some of the gentlemen he had mentioned were working simply for the love of science, whilst others were working on a pittance which some of them would not think well to give to their upper clerks. They lamented in this country that they had not some of those liberal men who in America had identified themselves with scientific institutions. Parliament had been liberal enough in these matters, and it afforded him great pleasure in this connection to say that to Sir Gordon Sprigg they had a right to be thankful, because he had always acted to them, he would not say with liberality, because that was not the word to use in connection with public funds, but with a just appreciation which had not always been met with amongst his predecessors. Not only as head of the Government, but as a personality he called upon the Premier to formally open the institution in which they now found themselves.

Sir Gordon Sprigg said he remembered the South African Museum in the year 1858, in which year he first went to that country. From that time to the present, from a public, not from a scientific point of view, he had taken a very great interest in the institution, and it afforded him very great pleasure indeed to declare the Museum open to the public. Those who had had an opportunity of visiting the Natural History Museum at South Kensington would see that the trustees had endeavoured to follow out in every possible way the design of that great institution. After the very interesting speech delivered by Mr. Merriman, which explained the objects of the institution and the designs of the trustees who had brought it to its present condition—something like approaching to perfection—he would not weary them with any further words, but would simply declare the Museum open for the public. At the same time the trustees recognised the fact that they had never appealed to him in vain for funds, and so long as he held his present position they never would appeal to him in vain. From time to time, so long as he held the position he now held, it would always afford him great pleasure to submit to Parliament any proposals submitted to him for consideration.

Dr. Gill said he had been requested by his fellow-trustees to say a word about one who was one of his dearest friends, who worked hard under great difficulties before a liberal—or should he say a wise—Sir Gordon Sprigg arose. He was the one who really bore the burden and the heat of the day, one who under great discouragement persevered in creating the nucleus of the Museum they were now about to see—and that man was Roland Trimen, F.R.S. On an occasion like the present it would be a great mistake if they were to omit the name of one who had done so much for natural history in South Africa. Mr. Trimen laid the foundation of that museum; they all owed him a great debt of gratitude, and they ought to remember it on that day.

THE SCIENCE OF ART.

PERHAPS the learned Dr. Bastian, of Berlin, has appreciated more than any one else that the psychological aspect of anthropology requires far more attention than has yet been devoted to it; the present writer would venture to assert that it is the department of anthropology that most urgently requires students. No doubt the subject is difficult, but the reward will be great. Experimental and observational psychology have received but scant attention in this country, and the psychology of the lower races has been totally ignored by us.

Of late years several anthropologists have studied the origin and modifications of the decorative designs of savage peoples; but only a very few of these have recognised that the tracing out of the history of a pattern or a design is of minor importance compared with the psychological processes that induced the original selection of the motive, and that operated in its subsequent elaboration or simplification. The scientific study of decorative art is a branch of psychology.

The editor of our contemporary *Mind* also appreciates this fact, and so Prof. G. F. Stout has printed a paper on "Evolution and Psychology in Art," by Dr. Colley March, in the October number of that journal. Dr. March accepts the definition of art as given in Dr. Murray's great dictionary: "Art is the application of *skill* to implements of utility, to subjects of taste, such as poetry and dancing, and to works of imitation and design, such as painting, sculpture and architecture." For the sake of convenience, Dr. March divides art into: (1) Artifice, of purely utilitarian intention. (2) Artistic treatment, or the shaping or arrangement of the details, parts, colours or outlines of implements or structures, whether utilitarian or not, so as to "please the eye." (3) Ornament: works of utility are necessary; man is compelled to make things. We understand why, in the making, they should be artistically treated, for the eye has always been accustomed to see outlines that represent the most functionally useful, and utility is always pleasing. It is not quite so obvious why they should become the subject of Ornament. Ornament is a decoration applied to an object which could exist quite well without it. Several examples of every-day objects are given, which show that Ornament sprang from structural handicraft, and became

rooted in the mind by association of contiguity, and that thus an expectancy was raised for them of such urgency that transfer took place as occasion offered. The discussion of this subject takes up the greater part of the paper. (4) Embellishment is finery, which may be sexual, bellicose, proud, aggressive, or wanton, and not unfrequently these articles of embellishment cannot be regarded as examples of Fine Art. (5) The works of Fine Art can be sharply differentiated from Ornament. They have an altogether independent existence, and are not subordinate to serial repetition. It is their aim and end to excite a high order of emotion. If we admit that Fine Art exists solely for the purpose of furthering emotion, we may safely conclude that emotional craving originated it.

"In conclusion," writes Dr. Colley March, "the five elements of Art may be analysed upon an urn. Artifice has moulded a hollow vessel of earth, and has baked it so that it will hold water. As the gourd was in many cases its model, Expectancy has required its base to be much narrower than strict utility might have provided; but the ring that was once a stand for it has now become its foot. Artistic treatment has given it outlines that we, or others, call graceful; has coloured its clay, and washed its surface with a translucent glaze; and has carried aloft in symmetrical curves those handles that were once of ozier or of cords.

"Round the foot and shoulder and neck, Expectancy has drawn bands of Ornament, skeuomorphs [designs derived from technical methods of construction in handicraft] of binding, of basketry, or of textiles; and a phyllomorph [or plant-design] is parasitic upon them. Embellishment has hung a foolish chain in a festoon between the handles. And Fine Art has filled the middle zone with a bas-relief, or a painting, that moves the soul.

> 'What leaf-fringed legend haunts about thy shape
> Of deities or mortals, or of both,
> In Tempe or the dales of Arcady?'

Thus, revealed upon a vase, we witness not alone the elements of Art, but its history, its psychology, and its evolution." A. C. H.

ADAM HILGER.

BY the death of Adam Hilger, which took place on April 23, the physical sciences, and especially astronomical physics, have suffered a loss which cannot be immediately made good. Standing in the front rank of practical opticians, he did much to promote scientific progress along various lines, his thorough scientific training enabling him to undertake optical work of the highest character.

Born in Darmstadt, in 1839, he early showed a marked inclination for the mechanical work in which his father was then engaged. For some years he was a mechanical engineer in Darmstadt, and he afterwards entered Ertel's famous establishment at Munich. He next came to London, but, though commanding a good salary, he found no opportunity of advancing his knowledge, and soon left for Paris, where he had the good fortune to find employment with the firm of Lerebours and Secretan. During this engagement he constructed many instruments, under the direct supervision of Foucault, and became fully acquainted with the theory, as well as with the practice, of his art. After the war of 1870 he came to London with his family. Here he was engaged with Mr. Browning, at first as a simple workman, but afterwards as foreman. Having completed a five years' contract, he commenced business on his own account at Islington. At these well-equipped works he produced the instruments which have brought him such a high reputation among physicists and astronomers throughout the world. He was especially skilled in manipulating quartz and Iceland spar for work on the ultra-violet rays, and had lately succeeded in making very perfect achromatic combinations of these materials. The special qualities of the new Jena glasses were also well known to him, and by their use he produced achromatic lenses of very short focal length, as well as prisms of very high dispersion.

We understand that the business will be, in all probability, continued by Mr. Otto Hilger. A. F.

A NIGHT IN MID-MAY.

NOW tender eve has kissed the drooping eyes
Of sleeping daisies; incense floods the air,
Bowed Nature kneeling at her vesper prayer;
Mid rustling leaves the pensive night breeze sighs.
In heaven's great garden brighter flowers arise;
While throned Arcturus fires the southern skies;
Aglow the coils of Berenice's Hair;
Her wonted path the patient moon makes fair.
Calm whisperers! of splendours far away,
Glad messages in golden light ye bring—
A heart's desire fulfilled one happy day,
In perfect love and never ending spring,
Where painless pleasure shall no more take wing,
Nor spectral winter close the eyes of May.

M. C. L.

NOTES.

THE Bakerian Lecture will be delivered at the Royal Society on Thursday next, May 20, by Prof. Osborne Reynolds, F.R.S., and W. H. Moorby. The subject will be the mechanical equivalent of heat.

DR. E. J. STONE, F.R.S., Radcliffe Observer at Oxford, died on Sunday last. Astronomy has thus lost one of its foremost workers.

WE join in the general expression of regret at the death of the Duc d'Aumale, a very distinguished member of the French Academy. He spent a great part of his life in England, and received the honorary D.C.L. at Oxford in 1891. He frequently appeared at the Athenæum Club, and his interesting personality was therefore known to many who were not his fellow-countrymen. By a deed of gift, executed in 1884, the Duc d'Aumale's château at Chantilly, and all its precious contents, was presented to the Institute of France, in trust for the French nation, subject only to his life interest in the château. The Paris correspondent of the *Times* gives particulars of this splendid gift. By the terms of the bequest Chantilly must preserve the character of a museum. The exterior wings are assigned as lodgings for the three curators, and the museum, under the supervision of the Institute, will be an institution open to the public. Besides this, the Institute, to meet the expense of the preservation of Chantilly, is given the forest, the annual clearings in which produce about 100,000 francs. It also possesses other portions of the estate, which will produce more than the sum necessary for the maintenance of a museum. France will thus always possess a magnificent monument to the memory of one who held national welfare very dear.

THE annual conversazione of the Society of Arts will be held at the South Kensington Museum, on Wednesday, June 16.

THE Yachting and Fisheries Exhibition at the Imperial Institute will be opened by their Royal Highnesses the Prince and Princess of Wales, on Monday, May 17.

THE *Lancet* states that the Government of India, recognising the arduous and valuable nature of M. Haffkine's recent work in connection with the bubonic plague, has sanctioned the grant of a monthly salary of Rs. 2000 to him instead of the

allowances hitherto given. This arrangement is to have a retrospective effect from the date on which he began work in Bombay.

THE Committee of the Puffin Island Biological Station have decided to offer facilities to students and others for the pursuit of scientific research at the station during the summer months. The island is well situated for the study both of marine zoology and ornithology, and the station is provided with sleeping accommodation in addition to the usual laboratories. Those wishing to avail themselves of the present opportunity should communicate with the Director, Prof. P. J. White, University College of North Wales, Bangor.

AT the annual meeting of the Institution of Civil Engineers, recently held, the Chairman was able to announce some important changes which have recently been made in the management of this Society, which are calculated to bring its proceedings more up to date. Hitherto, new members and associates have been admitted on a kind of guarantee, signed by a certain number of existing members, that the applicant is, by training and experience, duly qualified to act as a Civil Engineer; and although in recent years the Council have taken steps to ascertain that the candidate has been properly educated, no direct examination has been required. In future, in addition to the requirements now in force, a test examination of the general and scientific knowledge of candidates for election into the class of associate members will be required. A further departure from old customs, which has also recently taken place, is that members can now vote for the annual election of the President and Council by balloting papers, without personal attendance at the meetings, as used formerly to be necessary. The roll of members of this Institution now numbers 6204, and is constantly on the increase. The last year's annual income amounted to 22,285*l*. A large amount out of the capital funds belonging to the Society has recently been expended on the new building in Great George Street.

WE regret to announce the death, on the 7th inst., of Mr. Abraham Dee Bartlett, the well-known resident Superintendent of the Zoological Society's Gardens in the Regent's Park. Mr. Bartlett was born in London in 1812, and was formerly in business as a dealer in natural history specimens. After a short period of office as head of the Natural History Department at the Crystal Palace when it was instituted, Mr. Bartlett was appointed Superintendent of the Zoological Gardens in 1859, shortly after Mr. Sclater became Secretary, and continued in the efficient performance of his duties until about six weeks before his decease. In his practical knowledge of living animals Mr. Bartlett was unrivalled, especially as regards mammals and birds. No one knew better than he whether an animal offered for sale was sound or sick, or was a better judge of its value. He was also an excellent observer of the habits and structure of the animals under his charge, and communicated many valuable papers to the Zoological Society's scientific meetings on these subjects. One of the most remarkable of these was that on the shedding of the horns by the Prongbuck (*Antilocapra americana*), published in 1865. Mr. Bartlett's discovery of this curious phenomenon was at first discredited by the American naturalists, but the fact is now universally admitted.

THE death is announced of Mr. Matthew Carey Lea, of Philadelphia, at the age of seventy-four. From an obituary notice in the *American Journal of Science* we derive the following particulars of his work:—"Mr. Carey Lea was elected a member of the National Academy of Sciences in 1892, and the list of his more important papers then published contained fifty-four titles. These investigations for the most part related to the chemistry of photography, and especially to the action of light and other forms o. energy upon silver salts. He described photo-bromide and photo-iodide of silver, and in 1887 published a paper on the 'Identity of the photo-salts of silver with the material of the latent photographic image.' His most remarkable discovery, however, made in 1889, was that silver is capable of existing in three allotropic states. The first is allotropic silver proper, 'which is protean in its nature, may be soluble or insoluble in water, may be yellow, red, blue or green, or may have almost any colour, but in all its insoluble varieties always exhibits plasticity; that is, if brushed in a pasty state upon a smooth surface, its particles dry in optical contact and with brilliant metallic lustre. It is chemically active.' The second is intermediate in character, may be yellow or green, always shows metallic lustre, is never plastic, and is chemically indifferent. The third is ordinary silver."

WITH much regret we have to announce the death, on May 5, of Mr. J. Theodore Bent, who had just returned from a journey, with Mrs. Bent, in Sokotra, and in southern Arabia, in the course of which they had made some remarkable discoveries. Both had suffered from malarial fever, and Mr. Bent succumbed to a subsequent attack of pneumonia. For twenty years Mr. and Mrs. Bent spent a large part of each winter in travelling, and their later journeys have been described in several books. The more important were those in Greece and Asia Minor, in the course of which Mr. Bent acquired remarkable facility in modern Greek, and established his reputation as an archæologist; in the Bahrein Islands of the Persian Gulf; in Mashonaland, where he was the first to systematically study the wonderful ruins of Zimbabwe; in Abyssinia; on the Red Sea coast of Egypt; and to Hadramut, in southern Arabia. A leading object in the later journeys was to investigate the extension of the Sabeans at the period of their prosperity as a trading nation. Mr. Bent read many important papers to the Royal Geographical Society, the British Association, and other Societies. His unique collections of antiquities have been exhibited at the Royal Society's conversaziones, and his gatherings from numerous wanderings made his house a veritable museum. While his death is a serious loss to archæology and geography, the personal sorrow which it occasions is greater than in the case of most explorers. Mr. Bent had a very large circle of devoted friends, which, with a frank kindliness peculiarly his own, he was ever widening. The unaffected heartiness of his manner to all, and his readiness to assist every one engaged in kindred studies, will not soon be forgotten. Although he died at the age of forty-five, Mr. Bent leaves behind him the memory of more kind actions and helpful words than can be placed to the credit of most men whose lives have ripened into old age.

THE new Ostrich-and-crane-house in the Zoological Society's Gardens has lately been completed, and is already fully tenanted. The compartments on the south side accommodate all the struthious birds, which have now for the first time been brought together from different parts of the Gardens. The most recent addition is a fine adult male of the Somali ostrich (*Struthio molybdophanes*), remarkable for the bluish tinge of the naked parts, which in the Northern ostrich are red. The sixteen compartments on the north side are occupied by a fine series of cranes and storks.

THE anniversary meeting of the British Ornithologists' Union was held in the Zoological Society's Offices, 3 Hanover Square, on the 5th inst.; Mr. P. L. Sclater, F.R.S., in the chair. The report of the Committee gave a very favourable account of the Union's affairs, and of the progress of its journal, the *Ibis*, which has now been carried on successfully for thirty-eight years. Twenty-four new members were elected, raising the strength of the Union to more than 300. For the ensuing

year Mr. F. D. Godman, F.R.S., was elected president, and Mr. O. Salvin, F.R.S., secretary, the editors of the *Ibis* (Messrs. Sclater and Saunders) remaining as before.

THE first of a series of ten lectures, on the structure and distribution of birds, was given at the Zoological Society's Gardens on May 6, by Mr. F. E. Beddard, F.R.S., prosector to the Society. The lecture dealt with the main points in the external and internal anatomy of the class, special weight being laid upon those characters which are associated with the flight of birds. The lecturer gave a short *résumé* of the characters of the feathering of birds, not omitting to mention that, at present, baffling problem—the presence or absence of the fifth cubital remex. Attention was directed to the fact that although, on theoretical grounds, a continuous feathering, like that of the penguins and struthious birds, was to be looked upon as the primitive state of affairs, it was doubtful whether, in existing birds, the close feathering was not a secondarily acquired character. In support of this, the transitory existence of marked apteria and pterylæ in the chick-ostrich, as first described by Miss Lindsay, was pointed out. In describing the essential features of the skeleton, the lightness of the bones, the massing of the chief weight in the middle of the body, the structure of the hand, and various matters illustrative of the adaptation of that part of the organism to the purposes of flight, were dwelt upon.

PROF. HANKIN'S report to the Bombay Chamber of Commerce, concerning the infection of grain and the vitality of the bacillus of plague in infected grain, is thus summarised in the *British Medical Journal*. (1) The microbe has not been found in either stored grain or in parasitic insects inhabiting grain. (2) Grain can be infected by a pure culture of the bacillus of plague, so that an extract made therefrom will cause death from plague in animals (mice). (3) The potency of grain-infected extract rapidly diminishes, so that in a few days it does not kill. Thirteen days is the extreme limit of possible potency; but Prof. Hankin is led to the belief, by his experiments, that plague bacilli obtaining admission to grain stored as on board ship would certainly become non-infective in four to six days.

THE definition of a standard or standards of thermal efficiency for steam-engines was referred to a Committee of the Institution of Civil Engineers last year; and the gist of the conclusions, which have just been arrived at, is as follows: (1) That the statement of the economy of a steam-engine in terms of pounds of feed-water per horse-power per hour is undesirable. (2) That for all purposes, except those of a scientific nature, it is desirable to state the economy of a steam-engine in terms of the thermal units required per horse-power per hour (or per minute), and that if possible the thermal units required per brake horse-power should also be given. (3) That for scientific purposes the thermal units that would be required by a perfect steam-engine working under the same conditions as the actual engine should also be stated. The proposed method of statement is applicable to engines using superheated steam, as well as to those using saturated steam, and the objection to the use of pounds of feed-water, which contain more or less thermal units according to conditions, is obviated; while there is no more practical difficulty in obtaining the thermal units per horse-power per hour than there is in arriving at the pounds of feed-water. For scientific purposes the difference in the thermal units per horse-power required by the perfect steam-engine and by the actual engine shows the loss due to imperfections in the actual engine. It is pointed out that a further advantage of the proposal is that the ambiguous term "efficiency" is not required.

IN the *Mittheilungen der K. K. geographischen Gesellschaft*, in Vienna (vol. xl. Nos. 1 and 2), there is an exhaustive memoir on the Karlseisfeld or Hallstätter Glacier of the Dachstein. The first part is devoted to a minute examination of the topography of the region, and the second to an account of the methods and results of a careful survey made by the author. An excellent map is appended.

THE current number of *Petermann's Mittheilungen* contains the first instalment of a new estimation of the areas of non-European river-basins, by Dr. Alois Bludau. The numbers for South America are here given. Sixteen separate basins make up a drainage area of 16,275,000 square kilometres to the Atlantic; the Pacific slope, divided into four regions, accounts for 1,056,000 square kilometres; leaving the Titicaca and similar regions, without an outlet to the sea, the remaining 274,000 square kilometres.

WE have received from the author a contribution to the rapidly increasing literature of limnology—"Zur Entstehung der Alpenseen," by Dr. L. Swerinzew. Dr. Swerinzew criticises a good deal of recent work somewhat severely, and comes to the conclusion that a number of the types of lake-basins now regarded as different, are really identical as regards their mode of origin and development. About 90 per cent. of the Alpine lakes found in valleys are held to have been formed simply by the erosive action which gave rise to the valleys themselves.

M. DE LAPPARENT contributes to *La Nature* a note on some further considerations suggested by Nansen's discovery of a deep Arctic basin. He points out that the area we may now assign to the Arctic Ocean is almost the same as that given by Murray to the Antarctic Continent—about four and a half million square kilometres, while the depths observed by Nansen correspond in order of magnitude to the heights observed by Ross; and it is remarkable that a small area like the Arctic Ocean should give soundings equal to the averages obtained in the Atlantic and Pacific. These considerations, similar to those which have led Mr. Lowthian-Green to assume that the earth has a tetrahedral form, suggest that it may really be top-shaped, the spinning point, as it were, being the South Pole. Such a supposition would tend to reconcile the differences of astronomers and geodesists as to the ratio of the polar and equatorial diameters; for the latter base their value of the polar flattening, 1/294, upon measurements made almost entirely in the northern hemisphere. The value obtained by M. Tisserand from the precession of the equinoxes, 1/297, may be found sensibly correct, if the existence of the south polar protuberance, and consequent effects upon the form of the sea surface, are admitted.

SINCE the great earthquake of 1855, the strongest felt in Tokio was that of June 24, 1894, which forms the subject of a valuable paper contributed by Prof. F. Omori to the Italian Seismological Society. The entire land-area disturbed was about 110,000 square miles. The meizoseismal area was a band lying to the east of Tokio, and running north and south, from Iwatsuki to the Bay of Tokio. This band occupies the lowest part of the plain of Musashi, which is the continuation of the axis of the bay, and the earthquake was probably connected with a long fault lying beneath the meizoseismal band. Records of the earthquake were obtained at two observatories in Tokio. At one of these, situated on high and hard ground, the earthquake consisted of one prominent oscillation, preceded and followed by smaller vibrations; the maximum horizontal displacement being 73 mm. in the direction S. 70° W. and N. 70° E., and the maximum horizontal acceleration 444 mm. per sec. per sec. At the other observatory, which is on low and soft ground, the horizontal displacement was 130 mm., and the maximum acceleration about 900 mm. per sec. per sec. Prof. Omori believes that near the epicentre of a great earthquake, the movement is generally of the same simple character

as that above described, combined with a definite direction of the shock. Slighter earthquakes usually consist of a great number of small vibrations of nearly equal amplitude executed in different planes.

THE method of the computation of the Chinese calendar is described with clearness by Paul d'Enjoy in the *Bulletins de la Soc. d'Anthropologie*, 1896, p. 562. Every year is named by a combination of two words according to a fixed rule, and the special combination is supposed to indicate the fortunes of the year. The year 1896 was the period of the external hearth and the monkey; that is a time of dangers from abroad, which must be met by cunning and dexterity. Unfortunately for the Chinese, it was the Japanese that exhibited these qualities! In 1897 the Chinese enter calmer times, under the auspices of the internal hearth and the chicken. Next year the activity of the nation will be diverted from the cultivation of the soil, and turned towards watchfulness and the protection of the home, as the yearly combination is waste-land and dog. The months, weeks, days and hours are also described. Each of their hours corresponds to two European hours, of which seven belong to the day, and five to the night; the first hour commences at 11 o'clock at night. M. d'Enjoy states that Belgium is about to adopt the principle of the Chinese double hours for the official railway time-tables.

WHAT Sir William Flower has to say upon "Natural History as a Vocation," carries great weight; so parents with children who have proved the earnestness of their interest in nature's life and moods, should turn to an article in *Chambers's Journal* (May) if they wish to know exactly what are the prospects of the livelihood obtainable by following the inclination. "As to natural history as the regular occupation of one who has no other means of living," says Sir William Flower, "I have little to say that is favourable, as it is about the worst paid and least appreciated of all professions." There are signs, however, that the prospects are brightening, and the youth who feels confident of his ability "to scorn delights and live laborious days," may eventually find his way to a position as a lecturer, demonstrator, or curator. To pursue the vocation with any chance of success, he must have a considerable knowledge of modern languages and other subjects, as well as of natural history. He should begin wisely to collect specimens, and should educate himself by his collection; for, Sir William Flower points out, "The arrangement of a collection not only teaches the nature and properties of the objects contained in it; it also stimulates a desire to know more of the similar objects not contained in it, but to be found in other and larger collections. Still more important than this, as an educator, it calls out many valuable practical qualities: originality, order, neatness, perseverance, taste, power of discriminating small differences and resemblances, all of which will be found useful in other spheres of life." Sir William Flower's first "museum" was contained in a large, flat, shallow box with a lid; and one of the first specimens he possessed was a badly stuffed specimen of the dipper or water ousel.

IN the *American Journal of Mathematics*, xix. 3, Dr. G. H. Bryan gives a brief account of certain applications of the theory of probability to physical phenomena. The main difficulty in accounting for such phenomena by means of the principles of theoretical dynamics lies in the fact that the equations of motion of an ideal system always represent reversible processes, which in nature are conspicuous by their absence. The author proceeds to examine how far the difficulty may be overcome by introducing the theory of probability, especially in connection with the kinetic theory of gases, and he gives a short *résumé* of certain investigations by Prof. Boltzmann, from which it is found that, under certain assumptions, the most probable distribution of the coordinates and momenta of the molecules of a gas is that which has been termed the Boltzmann-Maxwell distribution. Unfortunately, however, the proofs involve certain initial assumptions, and, on varying the nature of these, the results as to the most probable final distribution will be different. It would thus appear that even probability considerations do not afford unassailable proofs of the law which forms the usually accepted basis of the kinetic theory—a result completely in accordance with Mr. Burbury's recent investigations, according to which assemblages of densely-crowded molecules do not conform to that law.

FROM a number of papers before us dealing with kathodic and Röntgen rays, we extract the following. Dr. Garbasso (*Nuovo Cimenti*, 4, iii.), in discussing the effects of products of combustion on the length of the electric spark, considers that if flames produce certain actions on the sparks, like those of Röntgen rays, it is because they are the seat of chemical phenomena, since in the products of combustion there exist dissociated molecules, in other words electrified particles. It seems probable that Röntgen rays and ultra-violet light act on sparks for the same reason.—Dr. Quirino Majorana (*Atti dei Lincei*, vi. 5) discusses the electrostatic deviation of kathodic rays, such as can be studied by the introduction of a second kathode or anode in the discharge-tube.—M. L. Benoist (*Bulletin de la Société Française de Physique*, 91) has attempted to discover the law of transparency of substances for Röntgen rays. Defining the *specific absorbing power* as the absorption produced by a layer of unit surface density (or of 1 decigramme per square centimetre), M. Benoist finds that for ordinary rays this power increases with the density, but the results vary with the quality of the rays themselves. The author advances the view that the law of density (according to which the specific absorbing powers of all substances are equal) is a kind of *limiting* law towards which the results of observation tend as rays of higher frequency are produced.—M. Jean Perrin, in discussing the laws according to which electrified bodies are discharged (*Bulletin de la Société Française de Physique*, 93) considers that when the rays actually reach the conductor, two separate factors must be taken into account, viz. the "metal effect" produced by the incidence of the rays on the conductor, and the "gas effect" due to their action when traversing the gas. By considering the two terms separately, the law of discharge can be represented by a simple mathematical formula.—M. Désiré Korda, in the same number of the *Bulletin*, calls attention to a remarkable dissymmetry produced by Röntgen rays in vacuum tubes, and which he has observed in experiments undertaken in conjunction with Dr. Oudin.

WE have received a report of the results obtained from the experimental fields for the cultivation of the sugar-cane in Antigua, by Mr. F. Watts and Mr. F. R. Shepherd. The experiments were mainly on the advantages to be derived from the use of mineral manures in the cultivation of the cane. The remarkable and unexpected result was obtained that the addition of phosphates to the soil diminishes the yield of sugar. Nitrogen, in the form of ammonium sulphate, sodium nitrate, or dried blood, has a slightly beneficial effect on the yield; potash a much greater beneficial effect.

THE Report of the Kew Observatory Committee for the year 1896 states that the magnetic curves during the past year have been quite free from any very large fluctuations. The earthquake of December 17 was shown slightly on the Declination curve, but more distinctly on the Horizontal Force curve. The mean Westerly Declination for the year was 17° 10'·8,

and the mean Inclination 67° 22'·3. In the various experiments carried on at the observatory, particular attention has been paid to observations of atmospheric electricity, and to the comparisons of mercury and platinum thermometers. The number of instruments verified during the year exceeded 20,500.

M. CAMILLE FLAMMARION brings together (*Bulletin de la Société Astronomique de France* for May) some statistics regarding the amount of rainfall in Paris since the year 1688, which discloses the remarkable fact that a gradual increase in the fall for the last two hundred years is indicated. A glance at the yearly means does not, perhaps, give such a decided apparent increase as a survey of the means obtained by grouping several years together. The following brief table, extracted from M. Flammarion's note, speaks for itself :—

	mm.
1689 to 1719	485·7
1720 ,, 1754	409·4
1773 ,, 1797	492·5
1804 ,, 1824	503·7
1825 ,, 1844	507·5
1845 ,, 1872	522·4
1873 ,, 1896	557·4

Whether this "increase" is actually due to more rain, or to some such causes as better positions for rain gauges, or more improved rain gauges themselves, one cannot with certainty say, but the amount of increase seems rather to negative this. The figures, nevertheless, are very astonishing ; and it would be interesting to examine other series of observations extending over a long period.

THE Geological Commission of Cape Colony has published a bibliography of South African geology, containing a list of nearly six hundred papers.

ASTRONOMERS will be interested to know that Mr. Henry Frowde has in hand "Tables for Facilitating the Computation of Star-Constants," by Dr. E. J. Stone, F.R.S., Radcliffe Observer at Oxford, modified and revised by Prof. H. H. Turner. We much regret to have to add to this announcement that Dr. Stone died on Sunday last.

IN papers recently published in the *Bulletin* of the American Museum of Natural History (November 1896 and March 1897), Dr. J. L. Wortman makes an important contribution to the knowledge of Mammalian descent. He unites six genera of primitive Mammalia, from various horizons in the North American Eocene, into a sub-order Ganodonta, and maintains that they are the ancestors of the New World Edentates. In following one of the families of this sub-order up through successive stages of the Eocene, he finds the genealogy to be completely traceable ; at the end of that period the line disappears altogether, but is taken up again in the Edentates of the Santa Cruz formation of South America. An almost inevitable conclusion from this is that about the end of the Eocene there was at least a temporary land connection between the two Americas.

MESSRS. JOHN WALKER AND CO., LTD., have sent us several packets of their "Perfection Envelope," which have been designed to do away with the necessity of licking, or otherwise moistening, the gum on the flap of an envelope in order to make it adhere. The gum is placed upon the back of the envelope instead of on the flap, so that by moistening the flap the envelope can be sealed without touching the gum with the tongue. The advantage thus gained is not very clear, for it is possible in the case of any envelope to moisten the back instead of the gummed flap. What is really required is a simple device for sealing envelopes without going through the very objectionable practice of licking them.

A SECOND edition of Prof. Lester F. Ward's "Dynamic Sociology, or Applied Social Science, as based upon Statistical Sociology and the less Complex Sciences" (two volumes) has been published by Messrs. D. Appleton and Co. The work first appeared in 1883, when there was not a chair of Sociology in any University in the world. Now there is a small army of active professors of Sociology in the United States alone, and the demand has consequently arisen for a new edition of Prof. Ward's pioneer work. Very little revision has, however, been made. An amusing story is told by Prof. Ward with reference to his volume. The book was interdicted in Russia, but the grounds upon which the action of the Russian Government was based were not clear until a correspondent suggested that the cause of trouble was the title, which appeared to be "a compound of *socialism* and *dynamite*."—A second edition of Dr. L. Edmunds' "Law and Practice of Letters Patent for Inventions" has been prepared by Dr. T. M. Stevens, and is published by Messrs. Stevens and Co. The first edition of the book appeared in 1890, and was reviewed in our columns in that year (vol. xliii. p. 53).—Prof. E. A. Schäfer's very instructive "Course of Practical Histology" (Smith, Elder, and Co.) has reached a second edition. The volume is a practical handbook in which practicable methods are described. Its aim is "to assist the student to carry on histological work independently of the constant presence of a teacher"; and well is this purpose realised throughout the book. —Messrs. E. and F. N. Spon have published a third, considerably enlarged, edition of "The Engineer's Sketch-Book," by Thomas W. Barber. The work contains 2603 sketches of "mechanical movements, devices, appliances, contrivances and details employed in the design and construction of machinery for every purpose, classified and arranged for reference for the use of engineers, mechanical draughtsmen, managers, mechanics, inventors, patent agents, and all engaged in the mechanical arts."

AMONG noteworthy papers and other publications which have come under our notice within the past few days are the following :—Dr. Fridtjof Nansen contributes to the *Geographical Journal* (May) a valuable outline of the scientific results obtained during the Norwegian Arctic Expedition. The same journal contains a full report of the discussion of the North Polar problem, at the Royal Geographical Society on March 22.—Mr. J. Holt Schooling illustrates "The Weight of the Earth" with several ingenious diagrams in the *Strand Magazine*.—Three books, by Prof. C. Lloyd Morgan, referring to the human mind and animal intelligence, furnish the text for an article in the *Quarterly Review* (No. 370, April).—Two papers on the structure and physical characters of striped muscular fibre, and the phenomena of its construction, appear in the *Journal of Anatomy and Physiology* (April), and form useful contributions to a subject which has for many years furnished histologists and physiologists with material for controversy.—The notes on progress in petrography, contributed during 1896 to the *American Naturalist*, by Mr. W. S. Bayley, have been brought together in a pamphlet, which should prove very serviceable for reference.—In the *Proceedings* of the Royal Society of Victoria (vol. ix.), containing papers read before the Society during 1896, are described : A new species of marsupial from Central Australia ; aboriginal rock painting in the Victoria Range, County of Dundas, Victoria ; geographical distribution of land and fresh-water vertebrates in Victoria ; the temperatures of reptiles, monotremes and marsupials ; the "Burbung" of the New England Tribes, New South Wales, and the "Bora" of the Kamilaroi Tribes (these detailed descriptions of ceremonies of Australian native tribes are based upon personal observations made by the author, Mr. R. H. Mathews) ; a contribution to the knowledge of the Tertiaries in the neigh-

bourhood of Melbourne; and the values of the wave-lengths of the spectrum lines of the alkalies, as determined by a new periodic formula.—A discourse pronounced by the late Dr. du Bois-Reymond in honour of the memory of Hermann von Helmholtz, is now published by Veit and Co., Leipzig. The discourse is a full and valuable statement of Helmholtz's life and scientific work.

THE additions to the Zoological Society's Gardens during the past week include an Orang-outang (*Simia satyrus*, ♀) from Borneo, presented by Lord Ashburton and the Earl of Crawford; a White-crowned Mangabey (*Cercocebus æthiops*, ♀) from West Africa, presented by Mr. Bernard A. Collins; a Malayan Bear (*Ursus malayanus*, ♀) from Malacca, presented by Lord and Lady Ashburton; a Nightingale (*Daulias luscinia*), British, presented by Mr. W. H. St. Quintin; three Common Boas (*Boa constrictor*) from the Teffe River, Upper Amazons; a Brazilian Tortoise (*Testudo tabulata*) from Brazil, presented by Mr. H. C. Fernando Rohé; a Phayre's Tortoise (*Testudo emys*) from Borneo, presented by H.H. the Tuan Muda of Sarawak; a Forsten's Lorikeet (*Trichoglossus forstenii*) from Sumbawa, a Blue-faced Lorikeet (*Trichoglossus hæmatodes*), two Perfect Lorikeets (*Psitteuteles euteles*) from Timor, a Phayre's Tortoise (*Testudo emys*) from Borneo, deposited; a Malbronck Monkey (*Cercopithecus cynosurus*, ♂) from Congoland, two Phayre's Tortoises (*Testudo emys*) from Borneo, two Long-tailed Grass-Finches (*Poephila acuticauda*) from North-west Australia, purchased.

OUR ASTRONOMICAL COLUMN.

MAY METEORS.—During the month of May the number of meteors is by no means considerable, the records showing quite a dearth of deduced radiant points at this season of the year. One, however, which seems to be, to some extent, prominent (*Astr. Nach.*, No. 3418), is that which is situated in the region near the brightest star in Corona. The Greenwich observers in 1866 one evening recorded no less than seven first magnitude meteors, and five fainter ones, in the course of an hour; and Mr. Denning tells us that he himself made some very successful observations in 1885. This observer is of opinion that previous observations indicate the occurrence of a special shower, and he gives, as a mean of many determinations of the positions of radiant points, the coordinates 232°·8 + 28°·6. May 18 is given as the day on which special attention should be devoted to this shower.

CENTRALSTELLE TELEGRAMS.—We have received a communication from Prof. H. Kreutz, in Kiel, which informs us that he has taken over definitely the direction of the Central Bureau for astronomical telegrams, and that in future the telegraphic address will *not* be Bureau der Centralstelle, Koniglichen Sternwarte, Kiel, but Astronomische Centralstelle, Kiel. Prof. Kreutz also incloses the "Statutes" of the Centralstelle, which have been recently revised.

ACCIDENTAL ERRORS OF TALCOTT OBSERVATIONS.—From a series of observations, 500 in number, made with the object of determining the latitude of Hong Kong, Herrn Doberck (*Astr. Nach.*, No. 3418) states some interesting facts about the choice regarding magnitude of stars that will be useful to observers using the Talcott method. It has been previously found that neither the zenith distance, nor the amount of the difference of zenith distance, if within 10′, affects the error of the results; neither is the difference of right ascension, if less than 20 m., affected. Herrn Doberck suggests that these limits might with advantage be extended: it is better to "observe bright stars with zenith distance greater than 20°, difference of right ascension greater than 20 m., and difference of zenith distance greater than 10′, than to observe fainter stars within these limits, as the accidental errors of observation increase when the brightness of the stars decreases." Taking the average magnitude of each pair of stars from 3·5 magnitudes up to the 7th magnitude, he gives a table showing the probable errors of one observation for each increase of half a magnitude.

FURTHER STUDIES ON SNAKE POISON AND IMMUNITY.

PROF. CALMETTE, whose name is so indissolubly associated with the study of snake bites and their treatment by anti-venomous serum, has lately published in the *Pasteur Annales*, in conjunction with his assistant M. Delarde, a most interesting and highly important series of experiments helping to elucidate the mechanism of immunity. Endeavouring to throw light upon some of the problems surrounding this highly complex question, Calmette has selected two different kinds of toxin, the one vegetable and the other animal.

The vegetable toxin was furnished by the substance known as abrine, which is the active principle of the seeds or beans of *abrus precatorius*, a leguminosa common in India and South America. It is a highly toxic material, and one milligramme suffices to kill a rabbit in forty-eight hours. Very few animals apparently can resist its action, and so far as Calmette's observations go, this immunity is restricted to hedgehogs, fowls, tortoises, snakes (*couleuvres*) and frogs. It requires as much as ten milligrammes of abrine to destroy either a hedgehog or a fowl in forty-eight hours, whilst a tortoise only succumbs after a dose of thirty milligrammes.

The animal toxin selected for these experiments was, as might be expected, serpent venom, consisting of a mixture of venoms derived from various kinds of poisonous snakes.

In the course of his previous researches, Dr. Calmette was led to believe that snakes had a charmed life against all injections of serpent venom; but he now tells us that his earlier conclusion requires correction. He has succeeded in killing Egyptian asps and a serpent native to Indo-China by injecting doses of venom three times as great as that normally present in their respective poison glands, and he is, therefore, of opinion that although reptiles do possess great powers of resisting the toxic effect of serpent venoms, yet, contrary to what he at first supposed, their immunity to this poison is not absolute.

Various hypotheses have been suggested to account for this comparative immunity exhibited by reptiles to the effect of venom, and Prof. Fraser, of Edinburgh, has attributed this phenomenon to the presence in the blood of reptiles of some anti-toxic substance. Calmette, however, has shown that, far from protecting animals from the toxicity of venom, reptile blood causes their death. Experiments in this direction were not only made with the blood derived from the liver and other organs of a *naja tripudians*, but also with injections of a filtered aqueous emulsion of these organs, but in no case was any protective action recorded.

Again, the serum of pigs, which animals in some countries are specially trained for the purpose of hunting serpents, which they devour greedily without suffering the least inconvenience from their bites, the serum of these animals has no modifying action whatever outside the body, *in vitro*, on serpent venom, and has no protective action.

Similar experiments were also made with animals exhibiting a relative immunity to the toxic action of the vegetable poison, *i.e.* abrine. It was found that whereas the normal serum of hedgehogs, which animals possess a natural immunity to abrine poisoning, can protect other animals susceptible to this toxin from its lethal effects, yet to do so effectually large quantities of the serum in question must be employed. On the other hand, fowls and tortoises, although also naturally immune to the abrine toxin, can confer, by means of their serum, no protective power whatever upon other animals against this poison.

The next question approached by Calmette was whether these so-called refractory animals can elaborate anti-toxins, and in the course of his experiments on this subject he obtained some very curious results.

For these investigations abrine only was employed, and profiting by the fact that fowls and tortoises had proved very refractory to this toxin, these animals were chosen as subjects for the inquiry.

Two fowls were given, in the course of twelve days, about eight milligrammes of abrine. Whilst, as we have seen, ordinary fowl-serum can confer no immunity from the effects of abrine poison, the serum derived from the abrine-treated fowl was possessed of immunising properties. In this case, therefore, a refractory animal, normally incapable of yielding an anti-toxic serum, had been trained by artificial means to do so. Similar experiments made with another refractory animal gave, however, quite different results, for when tortoises were treated with abrine poison, instead of their serum acquiring any protective

property, it killed those animals into which it was injected, and by no amount of artificial training could their serum become endowed with any immunising effect. Exactly similar results were obtained with frogs, and whilst the normal blood of these animals was repeatedly proved to be quite devoid of all toxic action on mice, yet after the frogs had been inoculated with abrine, and trained to acquire an immunity beyond their brother frogs towards this substance, their blood invariably killed the mice into which it was injected. Dr. Calmette concludes from these observations that natural immunity to a particular toxin does not imply the existence of a specific anti-toxic substance in the blood of such refractory animals, and that whilst apparently warm-blooded abrine-refractory animals can be trained to elaborate anti-toxins, cold-blooded abrine-refractory animals cannot produce such anti-toxins in the normal conditions of their existence. The latter portion of this generalisation receives some support from Metchnikoff's observations of the same phenomenon in the case of tortoises and tetanic-toxin.

Prof. Calmette next proceeds to discuss the properties of serum derived from those animals in which the immunity to a particular toxin is not natural, but has been artificially induced. We are again for this purpose taken back to anti-venomous serum, and some additional information is given incidentally of the wonderful efficacy which characterises this remarkable remedy for snake bites. Perhaps one of the most astonishing properties of this serum is the rapidity with which it operates. Thus if two cubic centimetres of anti-venomous serum be inoculated into the marginal vein of a rabbit's ear, it at once confers upon the latter immunity towards snake poison. Immediately after the injection of the serum, venom sufficient to destroy an ordinary rabbit in a quarter of an hour may be injected with impunity into the vein of the other ear. Its degree of therapeutic efficiency is also extraordinarily intense, as is well illustrated by the following experiment: four rabbits are inoculated with a quantity of venom sufficient to destroy them in two hours; one of these is left, whilst the other three receive, one hour and three-quarters later, an intravenous injection of serum equal in quantity to one four-hundredth part of their weight. Whilst the unprotected rabbit dies in two hours, the other three remain in perfect health. "Voilà donc un sérum qui," writes Calmette, "d'emblée, sans reaction préalable de l'organisme, produit l'insensibilisation absolue des cellules à l'égard du venin."

Of great importance in their practical bearing are the experiments which are recorded on the *local* action of anti-abrine and anti-venomous serum respectively. As is well known, abrine was at one time used for the treatment of trachoma, but unfortunately the subsequent suppuration which attended its use was in many cases so intense and so dangerous that it had to be abandoned for therapeutic purposes.

Now Calmette has found that by applying anti-abrine serum to the local parts affected, the inflammatory action of abrine is modified in a very remarkable manner, and the hope is held out that by using this serum, and so controlling the inflammation induced by the application of abrine, this valuable substance may once more be reinstated in the therapeutics of ophthalmology. Anti-venomous serum has apparently the same local immunising action as the anti-abrine serum.

Another practical point of great importance concerning these serums is also dealt with in detail; this is the diagnostic value attaching to their use. Already Pfeiffer and other investigators have shown how, by means of serum, it is possible to differentiate between cholera and other non-pathogenic vibrios, and to distinguish the typhoid from the closely-allied *B. coli communis*. A most interesting opportunity occurred for testing the diagnostic power of anti-venomous and anti-abrine serums respectively. In India the natives frequently wreak their vengeance on their enemies by poisoning their domestic animals, and the substances selected for this purpose are those which they know will be with difficulty detected by expert analysis. Two materials are specially favoured by them for this purpose, *i.e.* abrine and serpent venom. One method of administering the poison consists in taking short pieces of wood shaped in the form of a club, in the thick end of which small-pointed rods are carefully fitted. These rods are composed of a hard greyish-looking substance. Armed with these tiny clubs, which they can easily conceal in their hands, they inflict small scratches, scarcely visible, upon the cattle, but in the production of which the pointed end of the little rod is broken off, and in this manner the cattle become inoculated with the poison. Some of these small broken-off points were sent by Mr Hankin, of Agra, to Dr. Calmette for examination. On dissolving these fragments in water and inoculating the liquid into rabbits, the latter died, exhibiting the symptoms typical of abrine poisoning. The same quantity of this liquid mixed with some anti-abrine serum produced no toxic result whatever. Thus Dr. Calmette considers his diagnosis of the poison employed as being abrine fully justified. In a somewhat similar manner the use of serpent venom was also detected.

These results open up a new avenue to the physiological detection of toxins, whether of animal, vegetable, or bacterial origin by means of serums.

Some extremely interesting experiments were also made to ascertain whether toxins and antitoxins were capable of modifying one another outside the body *in vitro*. The following examples give some idea of the results obtained. 5 cubic centimetres of anti-venomous serum were mixed *in vitro* with 4 milligrammes of cobra venom, and this mixture was injected intravenously into a rabbit. The animal remained unaffected; at the end of an hour, this same rabbit was again intravenously inoculated with 1 milligramme of venom. It died thirty-five minutes afterwards. Thus although its death was slightly deferred beyond that which was noted for the control animal, yet it succumbed almost as readily as if it had received no protective serum whatever. Again, 5 cubic centimetres of anti-venomous serum were mixed with 4 milligrammes of venom and 1 cubic centimetre of a 10 per cent. solution of hypochlorite of lime, and the whole was inoculated into a rabbit. This same animal, on subsequently receiving a dose of venom usually fatal, suffered no ill-effects at all. In this case, Dr. Calmette points out, that whilst the serum had remained unaffected by the addition of a chemical substance, the toxic nature of the venom had, on the contrary, been entirely destroyed. Hence it is claimed that when toxins and their anti-toxins are mixed *in vitro*, the former do not appear to undergo any change or modification through the presence of the latter. Therefore, either these substances can remain side by side outside the body intact, or, if any combination between them does occur under these circumstances, it is a combination which is so unstable that the application of heat or various chemical substances is able to easily bring about their disunion, restoring to either the properties they possessed before being brought into contact. Dr. Calmette, in concluding his most valuable memoir, records a large number of experiments made to ascertain what is the degree of protective power exercised by anti-toxic serums of different origin and certain liquids on animals inoculated with abrine. It has been found that broth freshly prepared, normal ox-serum, anti-tetanic serum, anti-diphtheritic serum, anti-anthrax serum, and, above all, anti-cholera serum, exert individually a decided immunising action with regard to abrine. Although the protective action of these so-called foreign serums is not so pronounced as in the case with anti-abrine serum, yet they do most undoubtedly confer a certain degree of protection. Dr. Calmette considers that this artificially induced immunity must be regarded as a condition in which the cells of the body are specially stimulated, and are thus enabled to either temporarily or permanently resist the action of particular poisons.

The mechanism of immunity will not permit itself to be lightly mastered, and it is only by the conduct of painstaking and patient inquiries, of which those just described are such a splendid example, that a comprehension of this most important as well as fascinating phenomenon can ever be hoped for.

ON THE VARIATION OF LATITUDE.[1]

AT the autumn meeting of the National Academy in 1894, which was the last occasion upon which the author asked for its attention to this subject, he presented the numerical theory of the motion of the pole, synthetically derived from the observations from the beginning of the history of the astronomy of precision up to that time, in its complete development, exactly as it stands to-day. Since then he has been interested to compare it with the various series of observations, as they have been published from time to time, not only for the purpose of verification or improvement of the numerical values of the various constants, but also to detect any additional characteristics which these later data might make apparent. These additional investigations have individually been neither extensive nor important enough to call for separate publication; since their general result has been merely a satisfactory confirmation of the

[1] Abstract of a paper read before the National Academy of Sciences at Washington, April 21, by Prof. S. C. Chandler.

previous deductions as to the nature of the laws of these motions, without furnishing material improvement of the numerical elements. But sufficient material has thus been gradually accumulating to make the present communication of some interest.

The new material to be here utilised consists of the various series of observations by Talcott's method up to the middle of 1896, as far as published, at the following European stations, named in the order of longitude: Kasan, Vienna, Prague, Berlin, Potsdam, Karlsruhe, and Strasburg. America has Doolittle's series at Bethlehem, which was brought to an end in the summer of 1895. He is now carrying forward a new series at Philadelphia, of which the results may soon be expected. Of the series at Columbia University, by Rees, Jacoby and Davis, begun in the spring of 1893 and still current, the results for the first fourteen months came into the author's hands a few days ago, so that he was able to incorporate them in his investigations.

The curves of latitude-variation from these various series were then exhibited, and comparisons made with the known numerical theory. This shows a concordance and fidelity of representation which is in every way satisfactory, the difference between computation and observation being practically within the range of the uncertainty of errors of observation.

A determination of the elements of the ellipse of the annual component of the polar motion was then presented, made from the new observations independently of the older ones previously used. The resulting elements are practically identical as to form, size, and position. This seems to show that the axis of this elongated vibratory motion is stationary on the earth's surface along a meridian forty-five degrees east of Greenwich. This negative evidence as to any apsidal motion seems to be of extreme importance in its bearing on the theory of the earth's rotation.

A demonstration was then presented of the fact that since 1890 the circular 428-day motion has been diminishing its radius, in conformity to the requirements of the numerical theory derived from the observations from 1825 to 1890.

In addition to the above, a discussion of 718 observations of the Pole-star, made with the Pulkova vertical circle between 1882 and 1891, was given. This series is especially interesting and important in that it covers an interval during which we have very little other information, of an extended character, as to the variations of latitude. A comparison of the curves of observation and theory, thus provided for this decade, exhibited the most startling accordance, and seems to leave no possible doubt that Nyren's inference, that his observations do not betray evidence of the existence of the annual component of the polar motion, is erroneous and attributable to illogical methods in drawing his conclusions.

TECHNICAL EDUCATION IN LONDON.

THE work of the Technical Education Board of the London County Council has been favourably commented upon in these columns on many occasions. The Board includes among its members several well-known educationists; and in its Secretary, Dr. W. Garnett, it possesses an official whose knowledge of science makes him capable of taking a wide view of things, and of seeing the best and most practicable lines of development of technical education. The fourth annual report of the Board, presented to the Council on Tuesday, is a substantial testimony of work accomplished during the year ending with March. To do the report justice would take many columns of NATURE, but brief references to a few of the operations of the Board will, perhaps, suffice to give an idea of the valuable and extensive character of the work carried on.

The Board has continued its policy of attempting primarily to coordinate and develop the provision for technical education made by the various public institutions of the metropolis. By its grants of money, no less than by the expert assistance which it has placed at the disposal of the various governing bodies, the technical work of these institutions has been greatly extended during the past year. There are now no fewer than ninety-eight separate institutions in London to a greater or less extent supported by the Board, and inspected by its officers.

Special attention has been paid to developing and improving the instruction provided for apprentices, improvers and journeymen in the principal London industries. There are now more than two hundred well-equipped and efficient centres of definitely practical instruction in various trades. The character of the instruction given differs slightly, but, on the whole, it is of a kind that will assist industrial progress. As to instruction in electrical engineering, it is a noteworthy fact that from sixteen to eighteen students from the Royal College of Science have been attending the evening classes for electrical engineers at the South-West London Polytechnic Institute. This may be taken as good evidence of the Polytechnic's efficiency.

London now has eleven polytechnic institutions, which have on their rolls probably not fewer than 40,000 separate members or students. Nearly all the polytechnics provide instruction in science, art, technology, commercial subjects, literary subjects and domestic economy, and during the session 1895–96, before the Northampton Institute and the Northern Polytechnic were opened, the students registered at the London polytechnics, including the People's Palace and the Goldsmiths' Institute, in the several departments, were—

Science	8371
Art	2910
Technology	4692
Domestic economy	2678
Commercial subjects	8244
Total	26,895

The eleven polytechnic institutes referred to may be estimated for the current session 1896–97 to be spending in all their departments a total of about 128,000*l.* per annum, of which, roughly speaking, 29,000*l.* will probably be provided by the City Parochial Trustees, 25,000*l.* by the Technical Education Board, 22,000*l.* from City Companies, 12,000*l.* from private subscriptions and other endowments, 9000*l.* from Government grants, and 30,000*l.* from students' fees, &c. The total capital expenditure can only be roughly guessed at, but it will certainly have exceeded 500,000*l.* They may be expected to have in 1897–98, a total of about 45,000 separate students in all subjects, as compared with a corresponding total for 1892–93 of probably not more than 20,000.

The development of the higher departments at several of the polytechnics has during the last two or three years greatly increased the provision of higher instruction, especially in engineering, chemistry and physics. In the new and well-equipped laboratories now provided at these institutions by means of the Board's equipment grants, facilities are given for the student to pursue his work, without a break, from the elements of the subject up to the highest branches, and to undertake, in conjunction with his teacher, original investigation and research. A considerable addition has thus been made to the instruction of distinctly university rank now accessible to the London student, and it is estimated that, in addition to a large number preparing for matriculation, there are now over one hundred matriculated students in the polytechnics who are definitely studying for London university degrees in science. This number constitutes no small proportion of the total of matriculated students for science degrees, other than those in the medical schools, who are studying in organised educational institutes in London.

This great development of instruction of university rank in new institutions has increased the importance of bringing about a more systematic coordination of university education in London. The Board has accordingly continued to press for the early establishment of the promised new Teaching University for London, towards the technical departments of which it was proposed in Mr. Llewellyn Smith's report that the Board should contribute. The establishment of a well-endowed Teaching University for London, which should effectively coordinate and direct all the teaching of university rank that is now scattered about the metropolis, would probably do more than anything else to promote technical education. When this university will be established, it would be unwise to guess. Meanwhile the Board has attempted to bring about more coordination between the different institutions providing university instruction in technical subjects, and arrangements are in progress for courses of inter-collegiate lectures, mainly in post-graduate and specialist subjects, which will be open to all students of the various institutions concerned.

An interesting map, showing the places of residence of the thousand junior county scholars elected by the first four competitions of the Board, in the years 1893–95, accompanies the report. The map shows that the scholars were distributed with fair uniformity about the whole area of the county of London.

THE MANUFACTURE OF CARBORUNDUM AT NIAGARA FALLS.[1]

THE first carborundum furnace consisted of an iron bowl lined with carbon, and a carbon rod; a mixture of clay and carbon was introduced into the bowl, and the rod placed in the mixture. A current sufficient to fuse the mixture, or at least to bring it to a very high temperature, was now passed through the furnace, the iron bowl and carbon rod serving as terminals or electrodes. When the current was cut off, and the furnace had cooled down, it was opened, with the result that a few bright blue crystals were found surrounding the carbon rod.

The furnaces constructed after this first experiment approached more nearly in form the furnaces in use to-day. They were built of brick, their internal dimensions being 10 inches in length, 4 inches in width, and 4 inches in depth. The terminals were a pair of carbons, which could be moved longitudinally, thus permitting the distance between them to be altered at pleasure. These were essentially arc furnaces; that is to say, the idea was to form an arc between the terminals, and to bring about the necessary chemical changes by the high temperature thus produced. It was soon found, however, that this method of working was not satisfactory, and the incandescent furnace, which is the kind that is now adopted, was therefore constructed.

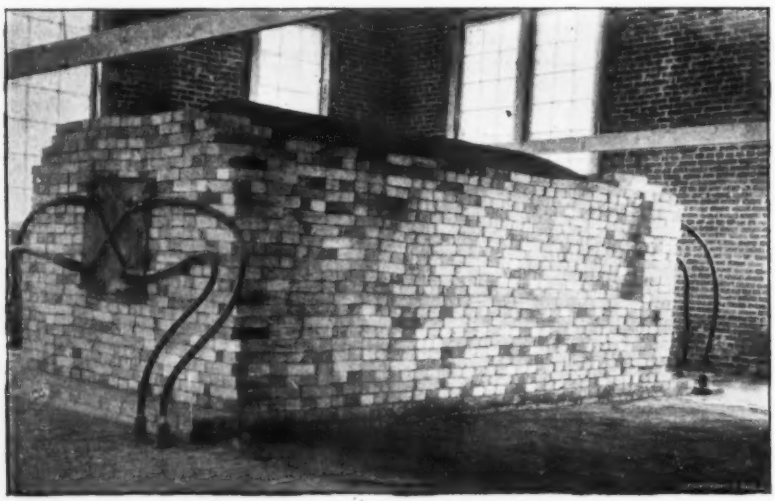

FIG. 1.—Carborundum furnace ready for operation.

Into furnaces of this kind a core consisting of granulated coke, which forms a continuous electrical connection between the carbon terminals, is introduced. By adjusting the diameter of the core to the proper size, it is heated to a sufficiently high temperature, by the passage of the current, to convert the surrounding mixture into carborundum.

It was at first supposed that the crystals formed in the furnaces were a compound of aluminium and carbon, but it was soon found that the amount and quality of the carborundum depended on the amount of silica present in the mixture. A good glass sand was, therefore, substituted for the clay in the mixture. It was also found that the addition of a little salt to the mixture facilitated the running of the furnaces. Some trouble was experienced from the gases formed during the running of a furnace, and to lessen this, sawdust was added to the mixture to render it porous, and to allow the free escape of the gas. The output of these small furnaces amounted to about a quarter of a pound a day.

The crude materials for the manufacture of carborundum at Niagara Falls are sand, coke, sawdust, and salt. These are ready for immediate use, with the exception of the coke, which must be reduced to kernels of a certain size, to be used as "core," and ground to a fine powder, to be used in making the mixture or charge for the furnaces. The furnaces are built of brick, and have the form of an oblong box, the internal dimensions being, approximately, 16 feet in length, 5 feet in width, and 5 feet in depth (Fig. 1). The ends are built up very solidly, with a thickness of about 2 feet. In the centre of either end are the terminals, consisting of sixty carbon rods 30 inches long and 3 inches in diameter. The outer ends of the carbons are enclosed in a square iron frame, to which is screwed a stout plate, bored with sixty holes corresponding to the ends of the carbons. Through each of these holes is passed a short piece of ¾-inch copper rod, fitting tightly in a hole drilled in the carbon. Finally, all the free space between the inside of the plate and the ends of the carbons is tightly packed with graphite. Each plate is provided with four projections, to which the cables conveying the current may be bolted. These ends are the only permanent parts of the furnace; the remainder is built up every time the furnace is operated.

The side walls of the furnace are first built up to a height of about 4 feet. Pieces of sheet iron are then placed at a distance of about 4 inches from the inner ends of the carbon terminals in such a way as to keep the mixture from coming in contact with the latter. The mixture is then thrown into the furnace until it is rather more than half full. A semicircular trench, having a radius of 10½ inches, and extending from end to end of the furnace, is now formed, the bottom of the trench being a little above the level of the bottom row of carbons. Into this trench is introduced the core, which has been carefully weighed, so that the amount required to make the core of the right size is used. All the core having been emptied into the trench, the top is rounded off neatly by hand, so that, when finished, we have a solid cylinder 21 inches in diameter and about 14 feet long, composed of small pieces of coke, and extending from the sheet iron plates at either end of the furnace.

The next operation is to make the connections between the core and the terminals. This is done by packing finely-ground coke into the spaces between the ends of the carbons and the pieces of sheet iron, after which the walls are built up to a height of about 5 feet, the pieces of sheet iron removed, and more mixture thrown in and heaped up to a height of about 8 feet.

All that is required now to make carborundum is the electric current. The current as supplied from the Niagara Falls Power Company has an electromotive force or pressure of 2200 volts, so that in order to use it in the furnaces it must be transformed to a lower voltage. The transformer at the Carborundum Works has a maximum capacity of 830 kilowatts, or about 1100 horse-power, and transforms the 2200-volt current into one of only 185 volts. Associated with the transformer is a regulator, by means of which the current from the former can be raised to 250, or lowered to 100 volts.

After the circuit has been closed in the transformer-room, no apparent change occurs in the furnace for about half an hour. Then a peculiar odour is perceived, due to escaping gases, and when a lighted match is held near the furnace walls the gas ignites with a slight explosion. When the current has been on for three or four hours, the side walls and top of the furnace are completely enveloped by the lambent blue flame of carbon monoxide gas, formed by the combination of the carbon of the coke with the oxygen of the sand. During the run of a single furnace 5½ tons of this gas are given off. At the end of four or five hours the top of the furnace begins to subside gradually,

[1] Abridged from a paper by Mr. Francis A. Fitzgerald, in the *Journal* of the Franklin Institute, February 1897.

fissures form along the surface, from which pour out the yellow vapours of sodium. Occasionally, the mixture on the top of the furnace is not sufficiently porous to allow the rapid escape of the gases. The result is, that the latter accumulate until the pressure is so great that, at some weak point in the mixture above, a path is forced open and the gases rush out violently. It is mainly for the purpose of avoiding this "blowing" that the sawdust is put in the mixture, since the former, by making the mixture porous, allows the gases to escape freely.

At the end of about twenty-four hours the current is cut off from the furnace, and it is allowed to cool for a few hours. Then the side walls are taken down and the unchanged mixture raked off the top of the furnace, until the outer crust of amorphous carborundum is reached. This crust is cut through with large steel bars, and can then be easily removed from the inner crust of amorphous carborundum. The inner crust is next removed with a spade, and the crystalline carborundum exposed.

A cross-section of a carborundum furnace presents an interesting and beautiful appearance (Fig 2). In the centre is the core, which, on examination, is found to be very different in some of its physical characteristics from the coke of which it was originally composed. It no longer possesses a bright metallic appearance. Many of the kernels are quite soft, and can be squeezed between the fingers, leaving on them a mark like black lead. In fact, the high temperature to which the core has been raised has driven off all impurities from the coke, leaving nothing but pure carbon, either in the amorphous or graphitic form. From the core radiate beautifully-coloured carborundum crystals to a distance of 10 or 12 inches. A single furnace yields over 4000 pounds of crystalline carborundum. Most of these crystals are not remarkable as regards their size, but in places where hollows have formed, large hexagonal crystals are found, sometimes measuring ½ inch on a side. At the distance of 10 or 12 inches from the core the crystals suddenly cease, and, instead, we find a thin layer of a light-green colour, which is the inner crust of amorphous carborundum. Beyond this is the outer crust of amorphous carborundum, and this also ends abruptly in unchanged mixture. Other curious substances are sometimes produced in the furnaces; for example, silica, which has the appearance of spun glass. On opening a furnace and cutting down to the core, a layer is found that appears at first sight to consist of very dull black carborundum crystals. On closer examination, however, it is found that though this material has the exact form of the carborundum crystals, it is nothing but pure carbon in the graphitic form.

After the carborundum has been removed from the furnace it is taken to a crusher, which consists of a large iron pan, rotated in a horizontal plane by means of a vertical shaft. A horizontal shaft, carrying two heavy rollers, is attached to a collar surrounding the vertical shaft, thus permitting a free vertical motion of the rollers which rest in the pan. The latter, in revolving, causes the carborundum to pass under the rolls, which break the mass of crystals apart. From the crusher the carborundum is taken to large wooden tanks, where it is treated for several days with dilute sulphuric acid to remove impurities. It is then thoroughly washed, dried, and graded.

Carborundum is apparently infusible; for after a certain temperature has been reached, decomposition commences, without fusion, and the crystals are broken up into carbon and silicon. It is quite insoluble in water or any acid. Its hardness lies somewhere between 9° and 10°, probably very close to 10°, which is the hardness of diamond. An attempt was made to obtain some idea of the relative hardness of diamond, corundum, and carborundum, by the following experiment.

A series of lines was scratched on a small plate of glass with each of the three materials, and the scratches examined with a microscope. The appearance of the lines made by the diamond and the carborundum crystal was indistinguishable; but that made with the piece of corundum was quite different, being rough, and not presenting the clean-cut outlines of the other scratches. This seems to show that carborundum is much nearer diamond than corundum in hardness, although it is not as tough. The specific gravity of carborundum is 3·23, which is less than that of emery, 1¼ pounds of the latter being equal in volume to 1 pound of the former.

Carborundrum is chiefly used at present as an abrasive, for which purpose it possesses many advantages over emery and corundum. The Carborundum Company produced during the year 1896, in round numbers, 1,191,000 pounds of crystalline carborundum.

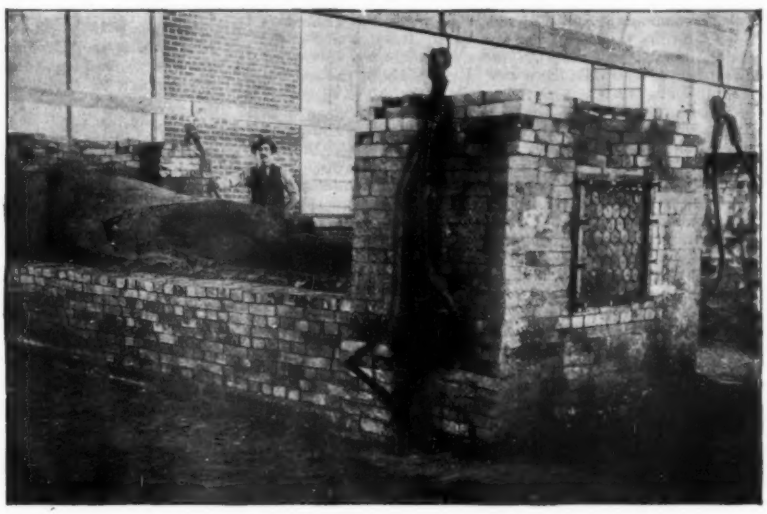

FIG. 2.—Furnace opened to show formation of carborundum around the core.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof E. B. Elliott and Prof. H. H. Turner have been appointed Electors to the Savilian Professorship of Geometry.

The Board of the Faculty of Natural Science have given notice that henceforth in the Final Honour School of Chemistry the use of books in the examination in Quantitative Analysis, and in any part of the examination, shall be at the discretion of the Examiners.

Trinity College has decided to build a laboratory adjoining the existing laboratory of Balliol College, and communicating with it. Such action in favour of Oxford science on the part of a College, far from rich, is especially commendable.

This term Mr. H. H. Champion, of Cambridge, is lecturing, for Prof. Turner, on "Lunar Theory." Prof. Ray Lankester will lecture on Arthropoda, and Mr. G. C. Bourne on Mechanical Theories of Development. Dr. Benham and Mr. Bourne are conducting the annual summer course of Practical Embryology.

Prof. E. B. Tylor's subject for this term is the Anthropology of Political and Social Institutions. Mr. Barclay Thompson

announces courses on Mammalian Morphology and Palæontology. The usual courses are being given in the departments of Physics, Chemistry, Mineralogy and Botany and Physiology.

In the Faculty of Medicine, Dr. Ritchie, Lecturer on Pathology, will give a course of practical instruction on Bacteriology. Lectures will also be given on Medicine, Surgery, and Materia Medica. Prof. Arthur Thomson is lecturing on the Uro-genital system.

April 13 being the twenty-fifth anniversary of the Zoological Station at Naples, Dr. Anton Dohrn sent a telegraphic message to the Chancellor, acknowledging the assistance rendered by the University to the Station.

Prof. Burdon Sanderson has been re-elected Chairman of the Board of Faculty of Medicine.

The large and valuable collection of butterflies offered to the Hope Department of the University by Mr. F. Ducane Godman, F.R.S., and Mr. Osbert Salvin, F.R.S., was accepted by Convocation on Tuesday, and the thanks of the University were voted to the donors. The collection has already been briefly described in NATURE (vol. lv. p. 524, April 1).

CAMBRIDGE.—A memorial, signed by 2100 resident undergraduates and bachelors of arts, has been presented to the Vice-Chancellor, protesting against the proposal to grant titles of degrees to women, on the ground that this would injure the position and efficiency of the University as a University for men. A counter memorial, signed by only 298 of the junior members of the University, has also been received. It states that in the opinion of the signatories the proposal would *not* injure the University. Meanwhile the notice of *non-placet* by the resident graduates has been circulated, and bears the names of about 280 members of the Senate, out of about 450 in actual residence. The list includes eighteen professors and 110 past or present tutors and lecturers. If, therefore, the decision lay with the resident body of teachers and officers, the result would be a decided negative; and there is no doubt that among the students the feeling against the contemplated change is overwhelmingly strong. The latter fact gives some colour to the assertion that the admission of women would probably be followed by a serious falling off in the number of men desirous of entering the University.

The proposal of the Special Board for Physics and Chemistry, that candidates for either part of the Natural Sciences Tripos should be required to submit to the Examiners their laboratory note-books, duly attested by the signatures of their teachers, has been adversely criticised in the Senate. It was feared that it might interfere with the good relations at present existing between teachers and students, and encourage the special preparation of note-books for the Examiners' inspection. The Report was referred back to the Board for reconsideration.

The dates of the next ensuing College Examinations for Scholarships and Exhibitions in Natural Science are announced as follows:—November 2: St. John's and Trinity, Pembroke, Caius, King's, Jesus, Christ's, and Emmanuel. November 30: Peterhouse and Sidney Sussex. December 7: Clare and Trinity Hall. April 1898: Downing. Information as to the value and conditions of tenure of the several emoluments may be obtained from the respective College Tutors.

WE understand that the late Prof. Edward D. Cope left an estate valued at over one hundred thousand dollars. Most of the amount is bequeathed to the University of Pennsylvania, and to establish a chair of Vertebrate Palæontology in the Philadelphia Academy of Natural History.

AMONG the grants just authorised by the legislature of the State of New York are: 2,500,000 dols. for the new public library in New York City; 500,000 dols. for an extension of the Museum of Natural History; 150,000 dols. for the new Zoological Park in New York City; and 10,000 dols. for the proposed public library in Brooklyn.

In a brief note (p. 21) on the application of the Hartley Institution for a share of the increased grant which it is proposed to give to the University Colleges of Great Britain, the term "professorial" staff was misprinted "professional" staff. Dr. R. W. Stewart, the Principal of the Institution, calls our attention to the fact that the Committee appointed to consider the distribution of the Government grant gave, in 1889, what almost amounted to a pledge that if certain defects in the Institution were remedied, a future application for a share of the grant might receive favourable consideration. The work and management of the Institution have since then been entirely reorganised, and it is on these grounds that the application has been renewed.

THE following are among recent appointments:—Dr. C. H. Draper to be head-master of the Municipal Technical School at Brighton; Miss M. Maclean to be demonstrator of anatomy, and Miss D. Clark demonstrator in the botanical laboratory, in Queen Margaret College, Glasgow; Mr. W. H. Lang to be lecturer on botany in the same college; Dr. Frech to be professor of geology and palæontology at Breslau; Dr. Walter Kruse to be professor of hygiene at Bonn; Dr. W. Ule to be professor of geography at Halle; Dr. Gustav Jäger, privat-docent in theoretical physics at Vienna, to be a professor; Prof. W. F. Edwards to be president of the Washington University, Seattle; Dr. Andr. Lipp to be professor of analytical chemistry in the Polytechnic Institute at Munich. Prof. Sissingle, of the Polytechnic Institute of Delft, has been called to the chair of Physics in the University of Amsterdam.

THE Technical Education Board of the London County Council will proceed shortly to award not less than five Senior County Scholarships, which are of the value of 60*l.* a year, together with payment of tuition fees up to 30*l.* a year, and are tenable for three years at university colleges and advanced technical institutes. These scholarships are confined to residents within the administrative county of London, and are only open to those whose parents are in receipt of not more than 400*l.* a year. Candidates should, as a rule, be under twenty-two years of age, though the Board reserves the right to give preference to candidates who are under nineteen years of age. The scholarships are intended to encourage more especially the teaching of science, and to enable those students who cannot afford a university training to pursue advanced studies for a period of three years in the highest university institutions in the country. Candidates must apply before Monday, May 17, to the Secretary of the Technical Education Board, St. Martin's Place, W.C.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xix. No. 2 (April 1897).—On the most perfect forms of magic squares, with methods for their production, is an interesting paper on these squares by Dr. E. McClintock, which treats the subject in a somewhat novel manner. As it was read before the American Mathematical Society so long ago as April 25, 1896, the references to the Rev. A. H. Frost's work on similar lines make no allusion to the recent memoir by this gentleman (the construction of Nasik squares of any order), which was read before the London Mathematical Society, June 11, 1896, and, in its printed form, occupied pp. 487–518 of vol. xxvii. of the Society's *Proceedings*. Dr. McClintock refers to the earlier papers in the *Quarterly Journal of Mathematics* (vol. vii. and xv.).—Dr. Chree contributes a complementary paper to his article in vol. xvi. Its title is "Isotropic elastic solids of nearly spherical form." The method of the two papers is practically the same, but the author states the differences in detail to be considerable. His principal object is to find what may be regarded as the change in pitch due to a small change in the shape of the surface; the result shows what effect an absence of perfect sphericity has on the frequency of vibrations.—Non-uniform convergence and the integration of series, term by term, by W. F. Osgood, is a paper which was read at the August (1896) meeting of the American Mathematical Society. The geometrical method for the study of uniform convergence, set forth in the present article, was treated at some length in a paper by the same writer, which we have noted in our abstract of the Society's *Bulletin* (vol. iii. pp. 59–86) for November 1896.—Two notelets close the number: viz. a note on the factors of composition of a group, by Ellery W. Davis, and simple proof of a fundamental theorem in the theory of functions, by R. D. Bohannan.—A loose sheet gives a very brief outline of Sylvester's career and work. Prof. Sylvester was the principal founder of the *American Journal of Mathematics* (in 1877), and he was the principal editor until his departure from America in December 1883. He contributed to its pages some fifty papers in all.

Bulletin of the American Mathematical Society, vol. iii. No. 7 (April 1897).—On Cayley's theory of the absolute, is a paper by Prof. C. A. Scott, which was read at the January (1897)

meeting of the Society. Miss Scott attempts to show, "as a matter of purely pedagogic interest," how simply and naturally Cayley's theory follows from a small number of very elementary geometrical conceptions, without any appeal to analytical geometry.—Lines common to four linear complexes, is a short note, by Dr. V. Snyder, which was read at the February meeting.—The cubic resolvent of a binary quartic derived by invariant definition and process, by Prof. H. S. White, was read at the Chicago Conference (January 1, 1897).—Dr. Isabel Maddison reviews two recent works on geometry, viz. Phillip's and Fisher's "Elements of Geometry," and H. D. Thompson's "Elementary Solid Geometry and Mensuration," which she thinks rise above the general level. Dr. Maddison also points out that the map-colouring problem was discussed (before Cayley and De Morgan wrote upon it) by Möbius, in his lectures in 1840. The problem was propounded to Möbius by Prof. Weiske, and is to be found in the *Berichte der Sächsischen Gesellschaft der Wissenschaften zu Leipzig*, Math.-physiche Classe, Bd. 37, 1885. The Note referred to is by Prof. Baltzer, and its title is "Eine Erinnerung an Möbius und seinen freund Weiske."—The Notes contain the mathematical courses at the Universities of Berlin and Harvard.

THE last number of the *Journal of the Russian Chemical and Physical Society* contains, in an appendix, the third instalment of the "Record" (*Vremennik*) of the Russian Chief Board of Measures and Weights. Most of it is given to an elaborate paper, by Prof. Mendeléeff, on the "Methods of Accurate or Metrological Weighings." The formulæ relative to the oscillations of the scales' index, and to the "condition" of the scales, are discussed in great detail, and new formulæ are given; while the discussion of some of the results has brought the Russian professor to the discovery of a new property of the parabola relative to the surface of a segment of it (*Comptes rendus*, 1895, p. 1467).—The same issue contains papers on the quantity of carbon dioxide contained in the air of the Weighing Hall of the Board of Measures and Weights, by A. Dobrokhotoff; the results of the verification at the Standards Department of the Board of Trade, in 1894 and 1895, of the Avoirdupois Pound belonging to the Russian Government, and the comparison of the Russian half-sashen with the Imperial standard yard, by H. J. Chaney, Mendeléeff, and Blumbach (in English and Russian); on the geographical position of the Board of Measures (chiefly its exact altitude above the sea-level); and a note, by Prof. Mendeléeff, on the agreement of the author's well-known formula for the density of water at different temperatures with the last measurements of the same, by M. Thiesen.

Bollettino della Società Sismologica Italiana, vol. ii., 1896, N.N. 7, 8.—Influence of the different nature and sensitiveness of instruments on the measure of the velocity of seismic waves, by G. Agamennone.—On the geodynamic system of the world, by G. Grablovitz.—Summary of the principal eruptive phenomena in Sicily and the adjacent islands during the six months July-December 1896, by S. Arcidiacono.—Velocity of propagation of the earthquake of Ahmed (Asia Minor) of April 16, 1896 (in French), by G. Agamennone.—Vesuvian notes for the year 1896, by G. Mercalli.—Notices of earthquakes recorded in Italy, August 31-September 8, 1896; the most important being a series of records of the Iceland earthquake of September 6.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 8.—"Further Note on the Sensory Nerves of Muscles." By C. S. Sherrington, M.A., M.D., F.R.S., Holt Professor of Physiology in University College, Liverpool. Received February 26.

I was somewhat surprised when, after the sensory nature of the structures originally termed muscle-spindles (Kühne) had been proved (Sherrington), I was unable to find in the eye-muscles any examples of these structures. I had expected to find in those muscles, on account of the great delicacy of their control and coordination, and in view of the well-known richness of their innervation, a field peculiarly favourable for the examination and study of "spindles."

I had noted that the intrafusal muscle-fibres, of the "red" variety as they are, undergo, when the nerve-trunk of a muscle has been severed, a much slower course of alteration than do extra-fusal muscle fibres, *i.e.* I found no pronounced degeneration for even two years following section. I therefore cut through *n. oculomotorius* at its origin, and examined the resultant degenerations in the eye-muscles which it innervates and in their individual nerve-trunks.

In the nerve-trunks, extra-muscular and intra-muscular, the Wallerian degeneration clearly demonstrated that, with the exception of a few minute fibres, of variable number, derived perhaps from the ciliary ganglion, *all* myelinate nerve-fibres in all these eye-muscles degenerate. Therefore these eye-muscles derive the vast majority of their myelinate nerve-fibres from *n. oculomotorius*. The sensory innervation of these muscles is not, therefore, derivable from the fifth cranial pair. In accord with this, I found (α) that severance of both trigemini caused no obvious impairment of the movement of the eye-balls, (β) that the combined severance of both *nn. trigemini*, and of both optic nerves, even after section of the encephalic bulb, did not severely depress the tonus of the eye-muscles. Now we know that section of the sensory spinal roots belonging to muscles does very severely depress the tonus of them.

At the same time, I was struck with the long distance to which many of the nerve-fibres in these muscles travel forward towards the ocular tendons of the muscles. I was the more impressed with this fact because direct examination proved that the regions of the distribution of motor end-plates in these muscles is almost confined to the middle portion of the fleshy mass of the muscle. Further investigation of the course and destination of the nerve-fibres at the tendon end of the muscle revealed them (both in cat and monkey) undergoing terminal subdivision, and in numerous instances passing beyond into the bundles of the tendon itself. The terminations of some of these nerve-fibres lie within the tendons; many recurve again towards the muscular fibres, and end just at junction of muscle-fibre with tendon-bundle. The nerve-fibres in so terminating frequently become thick—as I have described in the case of muscle-spindles—with shortened internodes.

My observations have included also the fourth cranial pair, and with like result. Investigation of the sixth cranial pair is also in progress.

It also appears from the above that the absence of the distinct Kühne-Ruffini "spindles" from a muscle does not exclude the possession by it of sensorial end-organs, and of afferent nerve-fibres. This point is not without importance, because examination of various muscles has led me to the conclusion that the "spindle-organs" are absent from the following muscles:—From all the orbital eye-muscles; from the intrinsic muscles of the larynx, though Pacinian corpuscles occur, as in various other muscles; from the intrinsic muscles of the tongue, and from the diaphragm. It is notable that all these muscles belong to that set which are innervated by nerve-fibres of rather smaller calibre (Gaskell) than those supplying the skeletal muscles generally; that is to say, are innervated by the non-ganglionated splanchnic efferent nerves of Gaskell.

"On Boomerangs." By G. T. Walker, M.A., B.Sc., Fellow of Trinity College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S. Received March 15.

A typical returning boomerang resembles in general outline a symmetrical arc of a hyperbola, and is about 80 cm. in length measured along the curve. At the centre, where the dimensions of the cross section are greatest, the width is about 7 cm., and the thickness 1 cm.

Of the two faces, one is distinctly more rounded than the other; in addition the arms are twisted through about 4°, in the same manner as the blades of a right-handed screw propeller.

Such an implement, if thrown with its plane vertical, will describe a circular path of 40 or 50 metres in diameter, rising to a height of from 7 to 12 metres, and falling to the ground with its plane of rotation horizontal at a point somewhere near the thrower's feet.

The flight may be regarded as a case of steady motion, of which the circumstances gradually vary. In the more complicated, as well as the simpler, paths, observation makes it clear that everything depends on the changes in direction and inclination of the plane of the boomerang, and that the character of these changes is always the same; if they can be explained theoretically, the peculiarities of the motion may be accounted for.

Since the effects of the different forces at work are conflicting, it is necessary to adopt quantitative methods, even if the degree of accuracy attainable is not high; accordingly ratios

comparable with a tenth are treated as small, and their squares neglected.

If we regard the boomerang as a thin, slightly distorted lamina, and integrate over it the forces indicated in S. P. Langley's paper on "Experiments in Aerodynamics" ("Smithsonian Contributions to Knowledge," 1891), we can obtain equations of motion. From these, treating the motion as steady (to the first approximation), we may deduce the values of the angular velocities on which the direction of the axis of rotation depends. Five cases are worked out numerically, and the various effects of the "rounding" and "twisting" agree in character with the experimental facts; the discrepancies in actual magnitude are not larger than might, from the nature of the case, have been anticipated.

The theoretical results may be further tested by applying them to determine the conditions favourable to the production of other flights in which, after the first circle, a loop is described, either in front of or behind the thrower; in each of these cases success has been attained. An explanation is also afforded of the returning of a boomerang without "twist," made by Mr. O. Eckenstein, and of the wonderfully long, straight trajectories of some of the native non-returning implements.

Geological Society, April 28.—Dr. Henry Hicks, F.R.S., President, in the chair.—The President, referring to the exhibit of models of the dorsal and ventral aspect of *Triarthrus*, said that these had been prepared and sent to him by Mr. Charles E. Beecher, of Yale University Museum. He was sure that they would prove of great interest to the Fellows, who were well acquainted with the extremely careful work which Mr. Beecher had done in connection with *Triarthrus*.—The following communications were read:—Note on a portion of the Nubian Desert south-east of Korosko, by Captain H. G. Lyons, R.E., with notes on the petrology by Miss C. A. Raisin, and water-analyses by Miss E. Aston. A general description of the physical structure of the area, which consists mainly of Nubian sandstone and crystalline rocks, was given. Coming from Korosko to the Murrat Wells, the crystalline rocks are first met with on the east side of Jebel Raft. At Wadi dur Nabadi are ancient gold-workings. The crystalline rocks are both massive and schistose. On the crystalline mass of Jebel Raft, and apparently overlain by the Nubian sandstone, is a very coarse conglomerate containing fragments of crystalline rock, which appears to be older than the Nubian sandstone. The Nubian sandstone has little or no dip, and shows very slight variation in composition. The water-supply of the Nubian Desert is directly dependent on the rainfall, which is very irregular. The wells are sunk in the detritus of the valleys, and contain a large amount of mineral matter in solution, which renders them almost undrinkable; while the second source of supply—the rain-water reservoirs—are deep holes in the ravines which intersect the crystalline hills. These holes are attributed to water-action; and in the reservoir of Medina in Jebel Raft the spherical stones which assisted in forming the pothole still occur. The author believed that these ravines and reservoirs were formed at an earlier period than the present, when the rainfall was heavier. Miss Raisin gave accounts of both massive and schistose crystalline rocks, and also of sedimentary rocks. The crystalline rocks described include gneiss, hornblendite, gabbro, often much altered and resembling some of the Alpine gabbros, some allied rocks containing lustre-mottled hornblende, other forms of diabase, quartz-diorite, granite, felsites, certain schistose and a few distinctly fragmental rocks. None of the igneous rocks could be stated with certainty to have originated as a lava-flow. Many of them had undergone much alteration since their consolidation, and the results of this were described. There was clear evidence in many cases of erosion by desert-sand and the formation of a weathered coating. The schistose rocks did not present a very modern facies, and might be late Archæan or early Palæozoic. The massive crystallines may belong to different epochs, but include some rocks (such as the gneiss) resembling Archæan. These seemed to mark an eastward extension of the anticlinal axis previously traced by Captain Lyons to Wady Halfa in the Nile Valley from the west. Miss Aston gave two tables, one of which showed the actual amounts of substances found in the wells of Murrat, Bir Tilat Abda, and Bir Ab Anaga, while the second showed their approximate constitution.—On the origin of some of the gneisses of Anglesey, by Dr. Charles Callaway. The author still maintained the occurrence of two pre-Cambrian groups in Anglesey, the later of Pebidian age. In his paper a description was given of the production of gneissic structure in rocks of the earlier group occurring in the south of the island. The products of metamorphism were similar to those described by the author in the Malvern area. (1) Simple schists, granite is converted into mica-gneiss, diorite into hornblendic or chloritic gneiss, and felsite into mica-schist; (2) Injection-schists.

Zoological Society, May 4.—Mr. Herbert Druce, in the chair.—Mr. Oldfield Thomas exhibited a selection of the Mammals recently collected by Mr. A. Whyte during his expedition to the Nyika plateau and the Masuku mountains, North Nyasa. Mr. Thomas described as new a squirrel (*Xerus lucifer*), brilliant rufous throughout, with a black dorsal patch; a reed-rat (*Thryonomys sclateri*), allied to *T. gregorianus*, but with a longer tail, whitish instead of yellowish underside, and narrower and differently shaped skull; a mole-rat (*Georychus whytei*), like *G. nimrodi*, but with longer and broader frontal premaxillary processes; a pouched mouse (*Saccostomus elegans*), of a general buff colour and with a longer head than *S. campestris*; and *Mus nyikæ*, a rat of the size of *Mus chrysophilus*, but darker in colour and with a more rounded skull. A new subgeneric term (*Gerbilliscus*) was suggested for *Gerbillus boehmi*, Noack, of which Mr. Whyte had sent home specimens. Mr. Thomas also stated that the peculiar bulbous-tipped tail hairs described in *Petrodromus* proved to be confined to and characteristic of East African examples of the genus, which might therefore be specifically separated from the Zambezi forms as *P. sultani*.—Mr. Howard Saunders exhibited, on behalf of Mr. Henry Evans, a series of instantaneous photographs of the great grey seal (*Halichœrus gryphus*) which had been taken in the Outer Hebrides.—Mr. J. E. S. Moore gave a general account, illustrated with the optical lantern, of the zoological results of his expedition to Lake Tanganyika in 1895 and 1896. Mr. Moore stated that the main object of the expedition had been to obtain materials for the morphological study of certain hitherto uninvestigated animal forms. It appeared that a key to the general interpretation of the lake-faunas of Central Africa would be most readily obtained by a study of their Molluscan Types. These showed that the faunas of most of the vast inland reservoirs of Africa were composed of normal lacustrine stocks, but that in Lake Tanganyika there were strange forms which certainly could not be included among such groups. All these forms appeared to have marine affinities; but, as they could not be directly associated with any living oceanic species, it was argued that they were probably the survivors of the marine fauna of some more ancient times, when Tanganyika was connected with the ocean. This theory was supported by the similarity of certain Tanganyika gastropods to ancient fossil shells.—A communication was read from Mr. Walter E. Collinge, on some European slugs of the genus *Arion*.—Mr. Sclater read a communication from Mr. Frederick J. Jackson, containing field-notes on the antelopes of Mau District, British East Africa.—The Rev. H. S. Gorham contributed a paper on the Coleoptera of the family *Endomychidæ* of the Eastern Hemisphere. Eighteen species were described, of which eleven were characterised as new.—Mr. F. E. Beddard, F.R.S., read a note upon the presence of intercentra in the vertebral column of birds. The existence of free intercentra in the caudal region was described in a number of genera belonging to many families of birds.

MANCHESTER.

Literary and Philosophical Society, April 27.—Dr. E. Schunck, F.R.S., President, in the chair.—Sir Henry E. Roscoe, F.R.S., was elected an honorary member. The following were elected officers and members of the Council for the ensuing year:—President, J. Cosmo Melvill; Vice-Presidents, Prof. O. Reynolds, F.R.S., Prof. A. Schuster, F.R.S., Charles Bailey, and W. H Johnson; Secretaries, R. F. Gwyther and Francis Jones; Treasurer, J. J. Ashworth; Librarian, W. E. Hoyle; other members of the Council, Prof. H. B. Dixon, F.R.S., Prof. H. Lamb, F.R.S., Dr. A. Hodgkinson, Francis Nicholson, J. E. King, and R. L. Taylor.—On the composition of some ancient Egyptian bronze and iron implements, by Dr. A. Harden. The author communicated the results of the analysis of two ancient iron chisels found in Thebes, and dating from about 600 B.C. Both of the implements contain a very small amount of carbon, and could not be rendered very hard by tempering. A specimen of bronze, dating from about 1500 B.C., was found to resemble modern bronze in its composition, consisting of copper alloyed with tin.

PARIS.

Academy of Sciences, May 3.—M. A. Chatin in the chair.—New classification of the Phanerogams, based upon the ovule and the seed, by M. Ph. van Tieghem. A summary of the preceding papers on this subject.—Researches on the composition of wheat, and on its analysis, by M. Aimé Gerard. During the process of milling, some 30 per cent. of the wheat is not included in the flour. The composition of this residue is given for samples of wheat of different origin, stress being laid upon the importance of suitable mechanical treatment preceding the chemical analysis.—The morphological signification of the caudal vertebræ, by M. Armand Sabatier.—Remarks by M. Faye on the presentation of the sixth volume of the "Annales de l'Observatoire de Nice."—Remarks by M. Darboux on the inauguration of the monument to M. Lobatschevsky at Kazan.—The Committees of Judges were appointed for the Grand Prize of the Physical Sciences, and for the Bordin, Damoiseau, Fourneyron, Pourat, and Gay Prizes.—On the law of variations of latitude, by M. F. Gonnessiat. Results of experiments undertaken with a view of seeing whether the meridian circle, at the same time that it furnished the absolute positions of the stars observed, could not also serve to show the variations of latitude with as much certainty as the differential methods hitherto adopted.—On the problem of Dirichlet, by M. S. Zaremba. An application to this problem of the notation of the theory of electricity.—On the comparative accuracy of the various methods used in securing the vertical in astronomical, geodesic, and topographical observations, by M. Ch. Lallemand. Four methods of levelling were compared—the use of a mercury bath as a plane mirror, the plumb-line, the spirit-level, and the contact of three points with a mercury bath, the last-named having been lately suggested as more rapid and more accurate. As a result of the experiments, supposing in each case the most favourable conditions, the spirit-level was found to be preferable, its accuracy being, in a portable apparatus, about fifteen times that of any of the other methods.—New properties of the kathode rays revealing their complex composition, by M. H. Deslandres. Whenever a kathode ray is deviated by a neighbouring body, it is, at the same time, divided into several distinct rays, which are unequally deviated.—On the partial polarisation of the radiations emitted by some luminous sources under the influence of the magnetic field, by MM. N. Egoroff and N. Georgiewsky. The polarisation in the case of most of the metals employed was shown exclusively in the rays most easily reversed. This was especially marked with copper. The rays from hydrogen and helium have, up to the present, given no definite results.—The part played by peroxides in the phenomena of slow oxidation, by M. A. Bach. In all the cases of slow oxidation by the air examined by the author, the application of reagents for hydrogen peroxide showed that this substance is invariably present. The results of experiments on the oxidising substance produced by the action of air upon palladium charged with hydrogen showed that in this case a higher oxidising power upon indigo than is possible for hydrogen peroxide, and it is suggested that a higher oxide, possibly H_2O_4, is present.—Study of the action of potassium permanganate upon cupric bromide, by MM. H. Baubigny and P. Rivals.—On the constitution of the metallic alloys, by M. Georges Charpy. From the study of a large number of alloys by the micrographical method conclusions are drawn concerning the nature of alloys in general. Eutectic alloys are stated to be not really homogeneous, but to consist of a mixture of the two constituent metals in the form of excessively thin laminæ, which are only visible under very high magnification.—Estimation of the dissolved oxygen in sea water, by MM. Albert Lévy and Félix Marboutin. The method previously adopted with success for ordinary potable water, namely, addition of ferrous oxide in known excess, and subsequent estimation of the excess with potassium permanganate solution, does not give good results in the presence of chlorides, and hence fails for sea water. The replacement of the permanganate by bichromate solution, however, removes this difficulty, the test analyses given being very concordant.—On the combinations of metallic salts with organic bases, by M. D. Tombeck. Aniline and pyridine bases are capable of forming definite combinations with the haloid salts of zinc and cadmium.—On a combination of silver chloride with methylamine, by M. R. Jarry. The compound formed is $AgCl(NH_2.CH_3)$. Its dissociation pressures are given for temperatures ranging from 0° to 65° C.—On the search for naphthol-yellow and analogous colouring matters in white wines and cordials, by MM. Alberto d'Aguiar and Wenceslau da Silva.—The evolutive cycle of the Coccidia in the Arthropods, by M. Louis Léger.—The origins of the vaso-dila or nerves and their trophic centres, by M. J. P. Morat.—On the parallel folds forming the mass of Mount Blanc, by M. J. Vallot.—On the Tectonic of the Nivollet-Revard Chain, by MM. J. Révil and J. Vivien.—On the determination of the proximate composition of the gluten in wheat flour, by M. E. Fleurent. The gluten is separated into two constituents, named respectively glutenine and gliadine, by treatment with a solution of alcoholic potash of suitable strength. The ratio of glutenine to gliadine determines the baking value of the flour.—Researches on the biological action of the X-rays, by MM. J. Sabrazes and P. Rivière.—The postulates of geometry, by M. Léon Fabre.—Influence of the temperature of fermentation upon the amount of nitrogen in wines, by MM. L. Roos and F. Chabert.

AMSTERDAM.

Royal Academy of Sciences, March 27.—Prof. van de Sande Bakhuyzen in the chair.—Mr. Verbeek, on the geology of Bangka and Billiton. Both islands consist of sedimentary rocks, probably of palæozoic age-sandstones, quartzites and shales, broken through by granites. Both of them are covered with quaternary sediments, loose sand and clay, the lowest (perhaps pliocene) strata of which contain tin ore; along the coast are alluvial deposits. The tin ore deposits are newer than the granite eruption, but probably they are not much more recent. Mr. Verbeek next dealt with "the glass-balls of Billiton." In the quaternary or, perhaps, pliocene tin ore deposits of Billiton there occur peculiar, rounded glass-balls with grooved surfaces; they are also found, though very rarely, in certain quaternary tuff strata in Java, and in the equally quaternary gold and platinum mines of south-eastern Borneo. The author classed these objects with the diluvial "Bouteille"-stones (Moldavites) of Bohemia, and the quaternary glass-balls found in Australia, and described by Stelzner (*Zeitschr. d. d. g. Gesellsch.*, 1893, p. 299). The origin of none of these bodies is known. They cannot be of volcanic origin, because the nearest volcanoes are too far distant, and have, moreover, produced glassy rocks of quite a different nature. For various reasons they cannot be artificial either. The author, therefore, took them to be of non-terrestrial origin, and considered it probable that they are thrown out by lunar volcanoes during the quaternary and, perhaps, already during the pliocene period. The author drew attention to the researches of Landerer (*Comptes rendus*, cix. p. 360, and cxi. p. 210), which, it seems, tend to show that a large portion of the surface of the moon consists of acid glass-rocks.—Prof. Hoffmann on the teleneurones in the retina of *Leuciscus rutilus*, in connection with researches by Mr. A. G. H. van Genderen Stort.—Prof. Haga presented, for publication in the *Proceedings*, a paper by Mr. J. W. Giltay, entitled "Polarisation of telephonic receivers." In 1884 the author proved that the speaking condenser required a charging battery to be employed, and that the telephone necessitated the use of a permanent magnet, because otherwise the apparatus renders the sounds to be reproduced an octave too high. The author has lately repeated the experiments with the better microphones of recent times, and found that some condensers (paraffin paper, gutta-percha paper) also speak intelligibly, though disagreeably, without a polarising battery being used, in consequence of the stronger telephonic charges penetrating into the insulator. A mica condenser, without a battery, is perfectly unintelligible. When it has been connected with the battery for a few seconds, it speaks very distinctly, and continues doing so for some seconds after the removal of the battery. When the battery is left in connection with the mica condenser for some time, the polarising action of the battery is found to decrease gradually. After a minute or two the sound has become quite unintelligible. As soon as the battery is removed, the sound immediately becomes very distinct, which, however, lasts only a few seconds. The author cannot yet give an explanation of this phenomenon. A not too tight coil of insulated wire without any iron gives perfectly the same results as a condenser with writing-paper: altogether unintelligible without the battery, quite distinct with it.—Prof. van der Waals gave, on behalf of Mr. Z. P. Bouman, for publication in the *Proceedings*, a survey of the results of an experimental inquiry into the emission and absorption of glass and quartz at different temperatures. The results obtained with the radio-micrometer (in a somewhat modified form) for plates 1 mm. in thickness may be formulated as

follows: The emission curve of glass reaches its maximum at 4·6 μ, shifting but little with temperature. The curves have a broad "flattening" at about 3·5 μ – 4 μ. The absorption curve shows the same particularity. The quotient $\frac{\text{emission}}{\text{absorption}}$ yields a curved line, whose maximum lies further towards the lesser λ's, absorption shifting in the inverse ratio to T. The emission and absorption of quartz correspond to each other. The two curves exhibit the same downward bends. In the quotient $\frac{\text{emission}}{\text{absorption}}$ the errors (per cent.) are too great to pronounce a positive opinion.

DIARY OF SOCIETIES.

THURSDAY, MAY 13.

ROYAL SOCIETY, at 4.30.—An Attempt to cause Helium or Argon to pass through Red-hot Palladium, Platinum, or Iron: Prof. Ramsay, F.R.S., and M. W. Travers.—On the Negative After-Images following Brief Retinal Excitation: Shelford Bidwell, F.R.S.—A Dynamical Theory of the Electric and Luminiferous Medium. Part III. Relations with Material Media: Dr. J. Larmor, F.R.S.—On a New Method of Determining the Vapour Pressures of Solutions: E. B. H. Wade.—On the Passage of Heat between Metal Surfaces and Liquids in Contact with them: T. E. Stanton.—On the Magnetisation Limit of Wrought Iron: H. Wilde, F.R.S.

ROYAL INSTITUTION, at 3.—Liquid Air as an Agent of Research: Prof. J. Dewar, F.R.S.

MATHEMATICAL SOCIETY, at 8.—On Cubic Curves as connected with certain Triangles in Perspective: S. Roberts, F.R.S.—An Analogue of Anharmonic Ratio: J. Brill.—An Essay on the Geometrical Calculus (Continuation): E. Lasker.—On the Partition of Numbers: G. B. Mathews.—Notes on Synthetic Geometry: W. Esson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Generation of Electrical Energy for Tramways: J. S. Raworth. (Discussion.)—Disturbances of Submarine Cable Working by Electric Tramways: A. P. Trotter.

FRIDAY, MAY 14.

ROYAL INSTITUTION, at 9.—Explosion-Flames: Prof. Harold Dixon, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Zodiacal Radiants of Fireballs: W. F. Denning.—On a New Binary Star with a Period of 5½ Years (β 883): T. J. J. See.—On the Mean Places and Proper Motions for 1900 of 24 Southern Circumpolar Stars: David Gill.—On the Determination of Terrestrial Longitudes by Photography: Captain E. H. Hills.—The Orbit of μ Draconis: S. W. Burnham.

PHYSICAL SOCIETY, at 5.—An Instrument for Comparing Thermometers with a Standard: W. Watson.—An Experiment in Surface Tension: A. S. Ackerman.—The Effect of Temperature on the Magnetic and Electric Properties of Iron: D. K. Morris.—The Formation of Mercury Films by Electric Osmosis: Rollo Appleyard.

MALACOLOGICAL SOCIETY, at 8.

SATURDAY, MAY 15.

GEOLOGISTS' ASSOCIATION.—Excursion to Chislehurst. Directors: W. Whitaker, F.R.S., and T. V. Holmes. Leave Charing Cross (S.E.R.) at 1.35; arrive at Chislehurst 2.19.

LONDON GEOLOGICAL FIELD CLASS.—Excursion from Snodland to Aylesford, to view the Gault. Leave Cannon Street 2.37.

MONDAY, MAY 17.

SOCIETY OF ARTS, at 8.—Design in Lettering: Lewis Foreman Day.

ROYAL GEOGRAPHICAL SOCIETY, at 2.30.—Anniversary Meeting.

VICTORIA INSTITUTE, at 4.30.—Paper by Dr. G. V. Pope.

TUESDAY, MAY 18.

ROYAL INSTITUTION, at 3.—Volcanoes: Dr. Tempest Anderson.

ZOOLOGICAL SOCIETY, at 8.30.—A Revision of the Lizards of the Genus *Sceloporus*: G. A. Boulenger, F.R.S.—Contributions to our Knowledge of the Plankton of the Faeroe Channel, II.: Dr. G. Herbert Fowler.—Further Contributions to the Knowledge of the Phytophagous Coleoptera of Africa, including Madagascar, Part II.; Martin Jacoby.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Notes on the Working of the Photo-Aquatint Process, and on some of the Apparatus used: T. Huson.

ROYAL VICTORIA HALL, at 8.30.—Adventure in South Africa: F. C. Selous.

WEDNESDAY, MAY 19.

SOCIETY OF ARTS, at 8.—London Water Supply: Prof. Percy F. Frankland, F.R.S.

ROYAL METEOROLOGICAL SOCIETY (Burlington House), at 4.30.—The Rainfall of Dominica, West Indies: C. V. Bellamy.—On the Mean Monthly Temperatures of the British Isles, 1871–95: R. H. Scott, F.R.S., and F. Gaster.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Exhibition of Specimens of Injections of other Objects: Ernest Hinton.

THURSDAY, MAY 20.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture—On the Mechanical Equivalent of Heat: Prof. Osborne Reynolds and W. H. Moorby.

SOCIETY OF ARTS, at 4.30.—Kerman and Persian Beluchistan, with special reference to the Journeys of Alexander the Great and Marco Polo: Captain P. Molesworth Sykes.

CHEMICAL SOCIETY, at 8.—The Theory of Osmotic Pressure and the Hypothesis of Electrolytic Dissociation; Molecular Rotation of Optically Active Salts; Heats of Neutralisation of Acids and Bases in Dilute Aqueous Solution: Holland Crompton.—The Platinum-Silver Alloys: their Solubility in Nitric Acid: John Spiller.—A Comparative Crystallographical Study of the Normal Selenates of Potassium, Rubidium, and Cæsium: A. E. Tutton.

FRIDAY, MAY 21.

ROYAL INSTITUTION, at 9.—Contact Electricity of Metals: Lord Kelvin.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Tunbridge Wells), at 3.—What can be done to save our Fauna and Flora from unnecessary Destruction?: Rev. J. J. Scargill.—How can the Technical Education Grant assist Local Scientific Societies? S. Atwood and J. W. Tutt.—Local Museums: W. Cole.

EPIDEMIOLOGICAL SOCIETY, at 8.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

BOOKS.—The Story of the Earth's Atmosphere: D. Archibald (Newnes).—The Naturalist's Directory, 1897 (Gill).—The Alternating-Current Circuit: W. P. Maycock (Whittaker).—Problems of Nature: Dr. G. Jaeger, edited and translated by Dr. H. G. Schlichter (Williams).—The Fauna of British India. Hymenoptera, Vol. 1.: Wasps and Bees: Lieut.-Colonel C. T. Bingham (Taylor).—The Evolution of the Aryan: R. von Ihering, translated by A. Drucker (Sonnenschein).—The Young Beetle-Collector's Handbook: Dr. E. Hofmann (Sonnenschein).—Domestic Science Readers: V. T. Murché, Book vi. (Macmillan).—The Engineer's Sketch-Book of Mechanical Movements, &c.: T. W. Barber, 3rd edition (Spon).—The Vertebrate Skeleton: S. H. Reynolds (Cambridge University Press).—A History of Ancient Geography: H. F. Tozer (Cambridge University Press).—System der Philosophie: W. Wundt, Zweite Umgearbeitete Auflage (Leipzig, Engelmann).—Das Ellenbogengelenk und Seine Mechanik: J. W. Hultkrantz (Jena, Fischer).—Lehrbuch der Zoologie: Prof. R. Hertwig, Vierte Umgearbeitete Auflage (Jena, Fischer).

PAMPHLET.—The Origin of the Celestial Laws and Motions: G. T. Carruthers (Bradbury).

SERIALS.—Strand Magazine, May (Newnes).—Scribner's Magazine, May (Low).—Journal of Anatomy and Physiology, April (Griffin).—Imperial University, College of Agriculture, Bulletin, Vol. iii. No. 1 (Komaba, Tōkyō).—Journal of the Royal Microscopical Society, April (Williams).—Atlantic Monthly, May (Gay).—Fortnightly Review, May (Chapman).—Geographical Journal, May (Stanford).—Bulletin of the American Mathematical Society, April (New York, Macmillan).—American Journal of Mathematics, Vol. xix. No. 2 (Baltimore).—American Journal of Science, May (New Haven).—Proceedings of the Physical Society. Vol. 15, Part 5 (Taylor).

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